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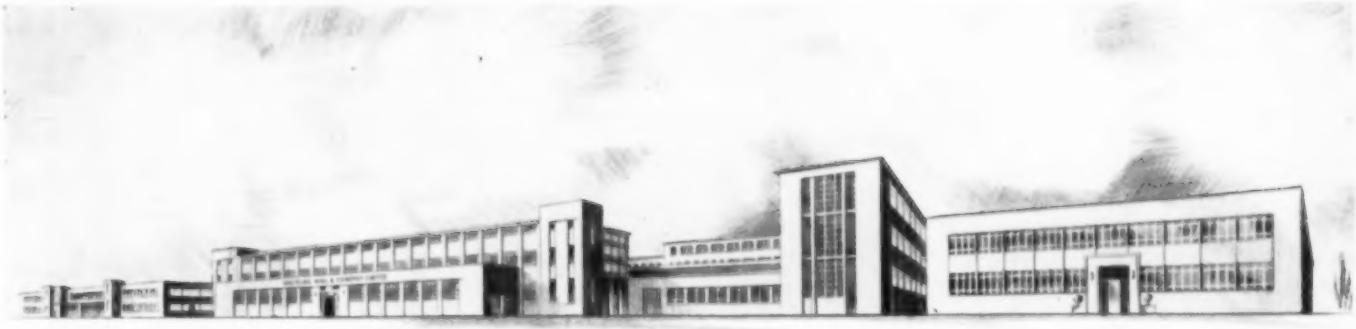

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PREFACE

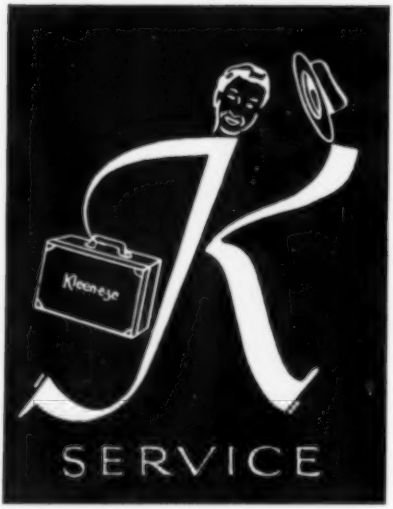
THIS book sets out to cover, so far as is possible in a single volume of handy size, the whole field of Industrial Finishing.

To what extent this has been achieved only close perusal will show, for here is a wealth of information, much of it in tabular form, grouped for convenience and easy reference under various headings.

The field is wide, partly because the range of finishes now demanded in Industry, and available, is great; and partly since the methods of application now employed vary enormously. Further, the surfaces to be treated differ as widely as do the treatments available, and Chemists, Engineers and Paint Technologists are only a few of those who are interested today in the diversified science of Industrial Finishing.

All of these will find much of value to them in this book. It is hoped, too, that the system of classifications and headings adopted will be found to make for convenient reference, and that the book, once used, will become a recognised tool and a " must " in all Technical Libraries, Laboratories and Workshops wherein Finishes and Finishing are matters of everyday concern.

Tabular form has been selected for listing much of the information contained in this Year Book since this has been proved in the past to be the most helpful and popular way of presenting data. Besides comprehensive Tables listing Cleaning Solutions, the Physical Characteristics of Electrodeposited Coats, the Properties of Solvents, the Outstanding Properties and Uses of Synthetic Coatings, Polishing Wheel Grit Sizes, Metal Colouring Treatments and the Physical Constants of Oils—to name but a few—there are Tables referring to Faulty Deposits from Plating Baths, and how to correct them, and Suggested Metal Etching Procedures, all immediately practical and handy for the man in a hurry. Workers in wood will find data pertaining to Furniture Finishing, and there is much to be read concerning paints and pigments, lacquers and Corrosion Protectives.



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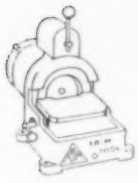

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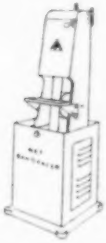

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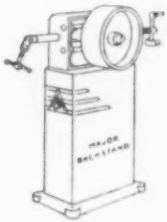

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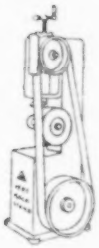
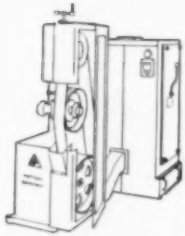

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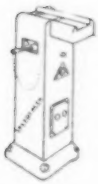
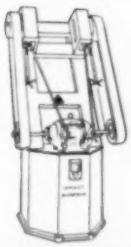

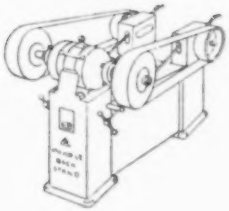

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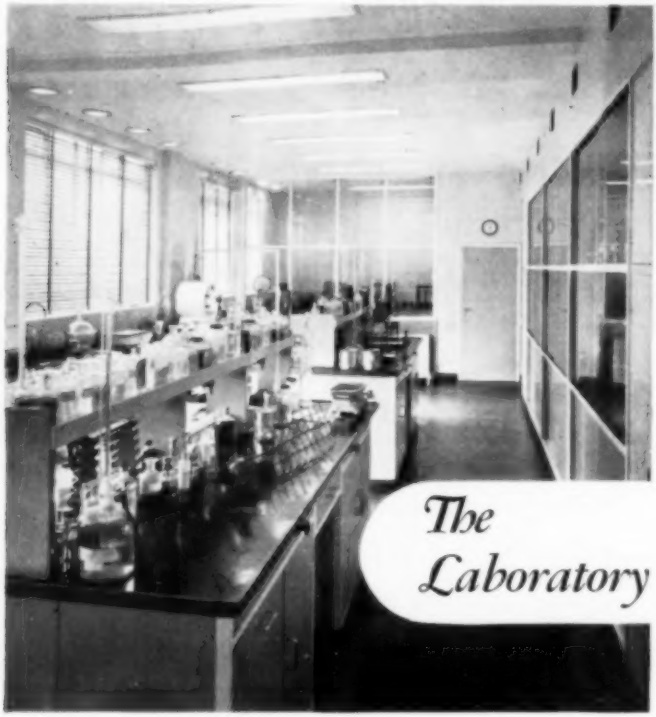

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COMPARATIVE DATA

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Cadmium (electro-deposited)	Marine Atmospheres of high humidity Urban 0·0003 in.	Anodic to iron Adherent Soft Matt or bright	Attacked by most acids Good resistance to alkalis Attacked by sulphur-containing compounds	—
Chromium (electro-deposited)	Industrial Marine Urban Sea-water Conditions of high humidity Mostly used as a composite coating with nickel or nickel/copper undercoats $\leq$ 0·002 in. of which chromium $\leq$ 0·0001 in. *Brass:* Copper/nickel undercoat Cr 0·00003–0·00005 in.	Cathodic to iron Porosity important Very hard Abrasion-resistant Uniform Porous	Good resistance to acids, even in presence of oxidising agent Attacked by hydrochloric acid Good resistance to alkalis Good resistance to sulphur-containing compounds	Very good

† *Extracted from,* "Protective Coatings for Metals." J

ON FINISHES†

Outline of process	Inspection and testing	Points about the process
(1) Alkali clean (2) Hot- and cold-water rinse (3) Pickle in either hydrochloric or sulphuric acid (4) Rinse in cold water (electrocleaning and anodic etching may also be used) (5) Plate from a sodium cadmium cyanide bath (6) Cold- and hot-water rinse. Dry (7) Heat-treat at 100°–200° C. for relief from embrittlement Still or barrel plating methods may be used	*Thickness* (1) Strip with 10 p.c. ammonium hydroxide + 5 p.c. ammonium persulphate• (2) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method• (2) Immersion in sea-water for 24 hours• (3) Humidity methods *Porosity* Immersion in 1 p.c. hydrochloric acid *Mechanical test* B.N.F. Adhesion Tester	(1) Not suitable for contact with rubber and some synthetic resins, unless chromatised (2) Not so good as zinc for industrial atmospheres (3) Tin or tin and lead undercoats may be used (4) The resistance to stringent atmospheric conditions may be further improved by (*a*) phosphatising and painting, or (*b*) chromatising and painting. At least 0·0003 in. thickness of cadmium is essential where such after-treatments are used (5) The cadmium plate may be scratch-brushed (6) Sprayed cadmium coatings may be used. Porosity is important in this case Scratch-brushing lowers the porosity (7) Cadmium may be plated on to brass
(1) Alkaline electroclean (2) Rinse (3) Anodic etch (acid) (4) Rinse (5) Chromium plate in an electrolyte containing chromic acid and sulphates or fluosilicates (6) Rinse : dry Stage (3) may be carried out in the plating bath *Process for plating brass* (1) Alkali clean (2) Rinse (3) Cyanide dip (4) Rinse (5) Plate in an electrolyte containing chromic acid and zinc sulphate (6) Rinse and dry To avoid embrittlement any pickling should be mild and in the case of hard steels followed by heating at 150°–200° C. After plating, heat at 100°-200° C.	*Thickness* (1) Strip in hydrochloric + perchloric acids• (2) Strip electrolytically in a solution containing sodium phosphate + sodium sulphate• (3) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method• (2) Salt-water immersion for 24 hours• (3) Humidity methods• *Porosity* Ferricyanide method• *Mechanical test* B.N.F. Adhesion Tester	(1) May be used in contact with rubber (2) Polishing increases the corrosion-resistance of the coating. Undercoats may be polished, resulting in a chromium layer of high lustre (3) Where chromium is plated directly upon steel, the hardness of the latter should not be greater than 500 V.P.N. and the steel should be stress-relieved at 150°–200° C. (4) Anodic cleaning is preferable to pickling. Cast irons and high carbon steels may be shot-blasted (5) For severe embrittlement, immersion in an oil-bath at 150°–200° C. for 1–5 hours may be practised, but it should be noted that this may have a softening effect upon the chromium plate (6) Zinc or zinc-base die castings require a nickel or copper/nickel undercoat before chromium plating

• Recommended test

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Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Lead (electro-deposited)	Marine Industrial 0·003–0·004 in. with copper undercoat Urban 0·001–0·002 in. with copper undercoat	Cathodic inland to iron. Weakly anodic to iron in marine atmospheres and salt water Soft, not very abrasion-resistant Acts as a lubricant in deep-pressing, etc. operations Fairly uniform	Attacked by most acids. Becomes passive in sulphuric acid Attacked by many alkalis Very good resistance to sulphur-containing compounds	Very poor
Nickel (electro-deposited)	Marine Urban Sea-water 0·002 in. minimum	Cathodic to iron Porosity important Hard Abrasion-resistant Porous Uneven	Attacked by most strong acids in the presence of an oxidising agent Very good resistance to alkalis Very good resistance at normal temperatures to materials containing sulphur	May be used in contact with steam Embrittlement occurs with hot flue gases containing sulphur

Outline of process	Inspection and testing	Points about the process
(A) (1) Alkaline electroclean (2) Pickle in 5–8 p.c. sulphuric acid (3) *Double* water rinse (4) Copper plate, 0·00002 in. (5) Rinse (6) Plate in bath containing lead fluoborate and glue (7) Rinse (B) Clean as above and after preplating with copper plate in the lead fluosilicate bath Still or barrel methods are used	*Thickness* (1) Electrical (e.g. thickness meter) (2) Microscopic methods• *Durability* (1) Salt spray method• (2) Salt-water immersion (3) Humidity methods• *Porosity* Ferricyanide method	(1) A copper undercoat is essential with the fluosilicate bath (0·00002 in.) (2) Burnishing improves the resistance to atmospheric corrosion (3) For more stringent conditions painting is advisable. The coating provides an excellent base for paint (4) During the cleaning stages, the effective removal of sulphuric acid is essential, hence the double rinse. Hydrochloric acid may also be used for pickling. Castings should be shot-blasted
(1) Degrease (2) Rinse (3) Pickle in 25 p.c. hydrochloric acid (4) Rinse (5) Cyanide dip (6) Rinse Alternatively, alkaline electrocleaning followed by anodic etching in sulphuric acid may be used (7) Plate from Watt's bath, viz. nickel sulphate + nickel chloride + boric acid (8) Rinse and dry *Bright plating* (1) Electroclean and etch (2) Plate in nickel-cobalt sulphate bath or sulphonate bath Still and barrel methods may be used Heat-treat at 100°–200° C. to relieve embrittlement	*Thickness* (1) Strip with a solution containing 25 p.c. nitric acid + 50 p.c. sulphuric acid (2) Electrical (e.g. thickness meter) or microscopic methods• (3) Drop and jet test• *Durability* (1) Salt spray method• (2) Humidity method• (3) Immersion in salt water for 24 hours• (4) Immersion in tap water for 24 hours *Porosity* Ferricyanide test• *Mechanical test* B.N.F. Adhesion Tester	(1) Not suitable for industrial atmospheres (2) Corrosion-resistance may be improved by polishing. For stringent conditions a thin coating (0·00003 in.) of chromium is often desirable (3) The bright nickel-cobalt bath affords a more corrosion-resistant coating than does the Watt's bath (4) Nickel is anodic to copper-base alloys, and thicknesses of 0·001 in. are required for atmospheric condition (5) Steel and zinc-base die castings may be electrocleaned, followed by dipping in weak sulphuric acid before bright plating. Zinc-base die castings may also be given an undercoat of copper (6) Anodic polishing in 73 p.c. sulphuric acid is an alternative to bright plating when performed upon the dull nickel plate (7) Where acid pickling is used prior to plating it should be very mild to avoid embrittlement troubles Anodic etching in sulphuric acid is to be preferred

• Recommended test

PROTECTION

Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Tin (electro-deposited)	Indoor or sheltered conditions, 0·0001–0·0003 in. Outdoor, industrial or urban, 0·00075–0·001 in. In contact with organic acids in the absence of oxygen	Cathodic to iron Porosity important Adherent Uniform Porous	Attacked by most acids Attacked by most alkalis Attacked by sulphur containing compounds	Useful life limited to < 200°C.
Zinc (electro-deposited)	Industrial Urban Conditions of low humidity 0·0003–0·0005 in.	Adherent Harder than cadmium Uniform Matt or bright Anodic to iron (cathodic in hot water)	Attacked by most acids Attacked by most alkalis Attacked by sulphur-containing compounds	Attacked by hot steam Little used above 100° C.

Outline of process	Inspection and testing	Points about the process
(1) Alkali or electroclean (2) Rinse (3) Acid pickle or anodic etch (4) Rinse (5) Plate from an alkaline sodium stannate bath *or* from an acid tin sulphate bath (6) Rinse and dry (7) Heat-treat (reflow) Cast-iron parts are usually given a preliminary strike from the alkaline stannate bath before plating in the acid bath. A copper undercoat may also be used Still and barrel plating methods may be used	*Thickness* (1) Strip with 0·1 p.c. antimony oxide in hydrochloric acid• (2) Strip electrolytically in 1 : 4 hydrochloric acid + iodine (3) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method• (2) Humidity method• (3) Tap-water test (4) Tinplate test *Porosity* (1) Hot water test (2) Ferricyanide test• *Mechanical test* B.N.F. Adhesion Tester	(1) Not as corrosion-resistant as either zinc or cadmium (2) Unless "reflowed" (i.e. heat-treated), the plate is inferior in corrosion-resistance to hot-dipped coatings (3) Tinplated articles are readily soldered (4) The plate may be further protected by painting or lacquering (5) Tin may be electrodeposited upon copper-base alloys : desirable thickness 0·0003–0·0005 in. (6) Readily corroded in outdoor marine conditions (7) The acid sulphate bath is particularly suitable for barrel plating or for the continuous tinning of steel strip (8) Sprayed tin coatings may be used
Cleaning As for cadmium *Cyanide bath* Sodium zinc cyanide + sodium hydroxide *Bright cyanide bath* Above electrolyte purified and addition agents. Very pure anodes used. After treatment dip in 0·5 p.c. nitric acid for 5 seconds *Acid bath* Zinc sulphate, aluminium sulphate, ammonium or zinc chloride and addition agents Relieve embrittlement by heat-treatment at 100°–200° C.	*Thickness* (1) Strip with 0·1 p.c. antimony oxide in hydrochloric acid• (2) Strip electrolytically with 10 p.c. zinc sulphate + 20 p.c. sodium chloride (3) Preece test (4) Electrical (e.g. thickness meter) or microscopic method *Durability* (1) Salt spray method• (2) Salt-water immersion for 24 hours• (3) Humidity methods• *Porosity* Electrographic ferricyanide method *Mechanical test* B.N.F. Adhesion Tester	(1) Useful for combating fatigue corrosion (2) Useful for cases where galvanic action is likely between steel and other metals with which it may be in contact (3) More adherent and not so brittle as the hot-dipped coatings (4) For severe conditions the coating may be (*a*) phosphatised and painted or enamelled, or (*b*) chromatised and painted (5) Bright zinc plate may be further protected by the application of a water-soluble shellac (6) A preliminary strike of cadmium or tin enables the satisfactory zinc plating of castings. Alternatively the addition of sodium carbonate to the bath using a high current density for a short time prior to normal plating is satisfactory. Treatment in a molten salt-bath followed by anodic cleaning *or* anodic pickling in neutral salt solutions may be used for grey and malleable castings (7) Anodic etching is preferable to acid pickling in the pre-cleaning stages (8) The acid bath is faster but has a lower throwing-power than the cyanide bath (9) Wires may be electrogalvanised (e.g. Bethanising) (10) Zinc may also be applied as a sprayed coating

• Recommended test

Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Anodic oxidation of aluminium and its alloys: Bengough-Stuart, Alumilite, Sheppard, Eloxal, etc.	Suitable for normal atmospheric conditions Suitable for marine use if properly impregnated and sealed Thickness varies, typical *ca.* 0·0001 in.	Adherent Abrasion-resistant Colour varies from transparent to yellow, black or white Porous Non-conductor	Attacked by both acids and alkalis unless suitably impregnated	—
M.B.V. process for aluminium alloys	Suitable for marine conditions and for immersion in sea-water if suitably impregnated and sealed	Not so hard nor so thick as the normal anodised film Very adherent Moderately abrasion-resistant Light to dark grey in colour Non-conductor	—	—

Outline of process	Inspection and testing	Points about the process
Precleaning (1) Degrease (2) Mild alkali clean (3) Rinse (4) Dip in 2 : 1 nitric acid (5) Rinse (6) Anodise (7) Rinse; dry (8) Impregnate (9) Seal in boiling water or 5 p.c. dichromate solution PROCESSES *Bengough-Stuart:* 3–10 p.c. chromic acid at *ca.* 40° C. Suitable as a batch process *Alumilite* and *Sheppard:* Sulphuric acid and organic addition agents. Suitable as a continuous process *Eloxal:* Oxalic and chromic acids	*Thickness* (1) Strip in 3·5 p.c. phosphoric acid and 2 p.c. chromic acid (2) Microscopic methods *Durability* (1) Salt spray method• (2) Humidity method• *Porosity* Aniline dye and blue pencil for Bengough-Stuart process *Mechanical*, etc. Breakdown voltage	(1) Good resistance to atmospheric corrosion is obtained by suitable impregnation with oils, fats, waxes, paints, enamels, metal hydroxides and inorganic pigments (2) Most anodising processes reproduce the basis-metal profile (3) All anodising processes work most satisfactorily upon pure aluminium (4) Al-Si alloys may be treated, giving dark films (5) Duralumin, zinc alloys containing up to 8 p.c. zinc, and copper-zinc alloys of the L 5 type can be successfully treated by all three processes. Above 5 p.c. copper and for Y-alloys only the sulphuric and oxalic methods are applicable (6) In general, heat-treated alloys are more satisfactory from the anodising point of view than the same alloys in the as-cast form (7) The "Brytal" and similar processes employ electrolytic polishing prior to anodising. This gives a surface with high reflectivity. Such coatings may be sealed with lanolin in white spirit, etc.
(1) Degreasing is not necessary unless the article is very dirty (2) Immerse for 5 minutes at 90°–100° C. in a bath containing 5 p.c. sodium carbonate + 1·5 p.c. sodium chromate, in water (3) Rinse; dry (4) Impregnation : (*a*) Lacquer or paint (*b*) Cobalt acetate (*c*) 5 p.c. sodium silicate for 15 mins. at 90° C. Flame seal	*Thickness* Microscopic method *Durability* (1) Salt spray method• (2) Salt-water immersion• (3) Humidity methods•	(1) The solution, together with caustic soda, may be obtained in the form of a paste and applied *in situ* with a brush, in the cold (2) The treatment is applicable to most aluminium alloys of low copper content and to pure aluminium (3) Treated sheet may be subsequently bent or rolled (4) Surface profile effects are reproduced (5) Some protection is afforded at breaks in the coating (6) The "Alrok" process is similar, sealing being performed in dichromate followed by painting

• Recommended test

Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
30-minute process for magnesium alloys (DTD 911)	Normal atmospheric exposure and for humid conditions (painted)	Adherent Flexible Absorbent	—	—
Cronak process for zinc alloys	Mild atmospheric conditions	Adherent Absorbent	—	—

Coating	Environment and thickness	Requirements	Types or Composition
Oils and greases	Suitable only for very mild or indoor storage conditions. These are temporary protectives only	(1) Contain rust-inhibitor (2) Easily removed (3) Easily applied (4) Fairly hard film (5) Water-repellent	Lanolin, resin and bitumen in naphtha. Lanolin, resin and zinc chromate in petro Lime soap in mineral oil Mineral jelly Mineral jelly and lanolin or beeswax Lanolin in white spirit Oil and lanolin or inhibitors Water-displacing oils

Outline of process	Inspection and testing	Points about the process
1) Pickle for 15–60 seconds in 5–10 p.c. sulphuric or nitric acids (use boiling 2 p.c. caustic soda for machined parts) 2) Rinse 3) Process in bath containing 3 p.c. ammonium sulphate, 1·5 p.c. ammonium dichromate, 0·35 p.c. ammonium hydroxide, for up to 30 minutes at boiling-point and *p*H 6·0–6·5 4) Rinse; dry 5) Paint, enamel, etc.	*Thickness* Microscopic method *Durability* (1) Salt spray method• (2) Humidity methods•	(1) Recent work suggests a *p*H of 6 and immersion time of 10 minutes for the best results (2) Articles should be treated immediately after machining (3) During processing, the articles should be kept at least 6 in. away from the steam coils (4) Painting or enamelling is essential for adequate protection
1) Pickle 2) Rinse 3) Immerse in a solution containing 20 p.c. sodium dichromate and 0·6 p.c. sulphuric acid for 10–30 seconds 4) Rinse; dry 5) Paint or enamel, etc.	*Thickness* Microscopic method *Durability* (1) Salt spray method• (2) Immersion in salt water• (3) Humidity methods•	(1) The coating thickens and darkens with increasing time of treatment (2) Similar coatings may be obtained by the use of oxalic and phosphoric acids which afford a suitable base for painting (3) Painting or enamelling are an essential part of the process

Method of Application	Inspection	Remarks
Dipping *or* Brushing *or* Spraying, as appropriate	*Durability* (1) Salt spray method• (2) Humidity methods•	(1) Preliminary phosphatising or chromatising of the surface improves the resistance to corrosion (2) Greases for use under tropical conditions should have a flow-point > 100° C. (3) Solubility in lubricating oils is a desirable feature for protectives used on spare machine parts. Grit must be removed (4) Oil to CS 1721 is suitable for arctic conditions (5) A suitable water-displacing oil is provided by CS 2060

• Recommended test

Comparative Data on Finishes

Coating	Environment and thickness	Requirements	Types or Composition		
Paints	Most paints suitable for very mild conditions Special paints for more stringent exposure 0·8–1·5 mil.	(1) Good adhesion (2) Low permeability (3) Continuity (4) Good surface preparation (5) Resistance to light and temperature changes (6) Presence of rust-inhibiting ion, e.g. chromate (7) Water-repellent vehicle	*Pigments* Lead chromate Zinc chromate Red lead Blue lead Zinc oxide Magnetic oxide of iron Red oxide of iron Zinc and aluminium dust Bitumen, etc.	*Fortifying agents* Alkyds Phenolics Urea-formaldehyde Oleo-resins, etc.	*Vehicles* Processed oils Linseed oils Tung oil Synthetic resins Chlorinated rubber, etc.
Lacquers and varnishes	Suitable for very mild or indoor conditions	As for paints (*supra*)	*Gums, etc.* Gum animi Benzoin Copal Gum damar Lac Mastic Rosin Synthetic resins Nitrocellulose, etc.	*Vehicles* Linseed oil Tung oil Turpentine Methylated spirits Amyl acetate, etc.	
Enamels	Suitable for most mild atmospheric conditions. Special enamels available for stringent conditions	As for paints (*supra*)	Cellulose enamels Oil enamels Oil-soluble phenol-aldehyde resins Glycerine-phthalic anhydride resins Urea or thiourea resins Bitumastic enamels		

Method of Application	Inspection	Remarks
Brush *or* Spray *or* Dip *or* Roller as appropriate	*Thickness* Strip with paint removers, e.g. trichlorethylene and acetone *Durability* (1) Salt spray method (2) Humidity methods• (3) Natural or artificial weathering• (4) Electrical tests (5) Salt-water immersion• *Porosity* Electrographic methods *Mechanical tests* (1) Abrasion-resistance (grit method) (2) Impact-resistance (falling hammer) (3) Scratch test	(1) Resistance to corrosion is materially improved by chromatising or phosphatising prior to painting (2) Sherardizing or metallising followed by painting may be used for stringent conditions (3) Adequate stoving is essential for maximum water-resistance (4) For outdoor work the paint should be applied under the best conditions, to prevent, for example, the trapping of moisture between two coats (5) Red-lead pigmented paints are suitable for industrial applications and zinc chromate types for marine use. Inhibitor pigmented rubber-base paints may also be used for marine exposures (6) Paints heavily pigmented with zinc dust and aluminium powder are anodic to iron and have good corrosion-resistance properties
Brush *or* Spray *or* Dip *or* Roller as appropriate	*Thickness* Strip with paint removers *Durability* (1) Salt spray method (2) Humidity method• (3) Natural or artificial weathering• (4) Salt-water immersion *Porosity* Electrographic methods *Mechanical tests* (1) Impact resistance (falling hammer) (2) Scratch test	(1) For more stringent conditions preliminary chromatising or phosphatising is essential (2) For humid and warm conditions particular care must be paid to the temperature and duration of stoving (3) The degree of stoving is dependent upon the film thickness among other things. Adequate stoving is also essential for good water-resistance
Brush *or* Spray *or* Dip *or* Roller as appropriate Conveyor and barrel methods in use	*Thickness* (1) Strip with paint removers (2) Electrical methods *Durability* (1) Salt spray method (2) Humidity method• (3) Natural and artificial weathering• (4) Salt-water immersion *Porosity* Electrographic methods *Mechanical tests* (1) Abrasion-resistance (grit method) (2) Impact-resistance (falling hammer) (3) Scratch test	(1) Organic enamels are employed for resistance to wear and tear and corrosive influences and where vibration and shock are possible (2) Bitumastic enamels show particularly good durability and are suitable for immersion in water (3) Adequate stoving is essential for good water-resistance (4) Chromatising or phosphatising are advisable for stringent conditions

• Recommended test

PROTECTION

Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Hot tinning	Industrial Urban In contact with organic acids in the absence of oxygen 1¼–1¾ lb. per basis box	Cathodic to iron Porosity important Adherent, fairly brittle although withstands mechanical deformation Uneven Porous	Attacked by most acids Attacked by most alkalis Attacked by sulphur-containing compounds	Useful life limited to < 200° C.
Galvanizing	Industrial Urban Conditions of low humidity 0·0003–0·0005 in.	Anodic to iron (cathodic in hot water) Adherent Fairly hard Uneven More brittle than electrodeposited coatings due to the alloy layer	Attacked by most acids Attacked by most alkalis Attacked by sulphur-containing compounds	Attacked by hot steam Little used above 100° C.
Sherardizing	Industrial Urban Conditions of low humidity 0·0003 in.	Anodic to iron Adherent, uniform Hard More brittle but not as thick as galvanized coatings	Attacked by most acids Attacked by most alkalis Attacked by sulphur-containing compounds	Retards the oxidation of iron and steel up to *ca.* 425° C.

Outline of process	Inspection and testing	Points about the process
(1) Pickle in 3-6 p.c. sulphuric acid (2) Flux in molten zinc chloride (3) Hot dip, etc.; entrance to pot, 307°–343° C. : exit from pot, 252°–288° C. Withdraw through palm oil heated to 240° C (4) Clean on cotton rolls (5) Polish Hand-dipping is also practised using a single bath at *ca.* 260° C. or two baths with an intermediate drawpot. The first is covered with tallow and works at 280° C., while the second is worked at 245°–250° C.	*Thickness* (1) Strip with 0·1 p.c. antimony oxide in hydrochloric acid• (2) Strip electrolytically in 1 : 4 hydrochloric acid + iodine (3) Electrical (e.g. thickness meter) or magnetic or microscopic methods *Durability* (1) Salt spray method• (2) Humidity method• (3) Tap-water test (4) Tinplate test *Porosity* (1) Hot water test (2) Ferricyanide test• *Mechanical test* B.N.F. Adhesion Tester	(1) Tinned plate may be readily soldered (2) The corrosion-resistance may be further improved by (*a*) electrodeposition of 0·0003 in. of tin on top of the tinplate, or (*b*) by painting or lacquering (3) Copper, cast iron and also aluminium may be hot-tinned by a suitable technique (4) Readily corroded by outdoor marine conditions (5) Cast iron articles are shot-blasted, plated with copper or pure iron, immersed in aqueous zinc ammonium chloride, and tinned by the two-bath technique
(1) Pickle in dilute sulphuric acid (2) Rinse (3) Pickle in dilute hydrochloric acid (4) Rinse and dry (5) Dip in molten zinc ammonium chloride flux (6) Dip in molten zinc containing small amounts of other metals at *ca.* 450° C. (7) Heat-treat (galvanneal) if required at 620°–710° C. for *ca.* 15 minutes	*Thickness* (1) Strip with 0·1 p.c. antimony oxide in hydrochloric acid• (2) Preece test : three one-minute dips• (3) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method• (2) Salt-water immersion for 24 hours• (3) Humidity methods• *Porosity* Electrographic ferricyanide method *Mechanical test* B.N.F. Adhesion Tester	(1) The addition of aluminium to the bath tends to lower the brittleness of the coating (2) The antimony content of the coating must not exceed 0·03 p.c. (3) The process is suitable for sheet or wire (4) For severe conditions the coating may be phosphatised and painted or chromatised and painted. The coating may also be painted directly after roughening by means of atmospheric exposure or acid etching (5) A sprayed coating of equivalent corrosion-resistance would have to be *ca.* 0·004 in. in thickness (6) The "Crapo" treatment for wire involves pre-treatment in a bath of molten lead prior to pickling
(1) Pickle (2) Rinse (castings should be shot-blasted) (3) Heat with powdered zinc at 350°–375° C. in a closed rotating system. The time of heating is dependent upon the thickness required	*Thickness* (1) Strip with 0·1 p.c. antimony oxide in hydrochloric acid• (2) Preece test : three one-minute dips• (3) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method• (2) Immersion in sea-water for 24 hours• (3) Humidity methods• *Porosity* Electrographic ferricyanide method	(1) Not so corrosion-resistant as galvanized coatings (2) Suitable where tolerance limits of *ca.* 0·001 in. are laid down (3) Further protection is provided by oil-blacking, e.g. Sherablak, lanolin impregnation, painting or enamelling. Preliminary roughening is not required before the application of paint

• Recommended test

Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Chromising	Most atmospheres	Hard, adherent	—	Very good
Lead alloys e.g. Terne plate (hot-dipped)	Industrial Marine Sulphurous atmospheres 20–40 lb. per double basis box	Cathodic to iron Porosity important Fairly hard, not brittle May be deformed Uneven Maintains good electrical surface conductivity	Attacked by most acids. Becomes passive in sulphuric acid Attacked by many alkalis Very good resistance to sulphur-containing compounds	Poor
Corronising (duplex coatings)	Most atmospheres according to the combination used	Dependent upon the type of coatings employed Order of thickness 0·0001–0·00075 in. *or* 0·001–0·004 in.	Mostly attacked by acids Usually have poor resistance to sulphur-containing compounds	Dependent upon the type of coating combination employed

Outline of process	Inspection and testing	Points about the process
Cementation (1) Pickle (2) Rinse; dry (3) Heat with powdered chromium and alumina in an atmosphere of hydrogen at 1350° C. (4) Polish if required	*Thickness* (1) Microscopic method *Durability* (1) Salt spray method* (2) Salt-water immersion (3) Humidity methods*	(1) Not so hard as chromium plate (2) May readily be polished. This improves the resistance to atmospheric corrosion (3) Oxygen and water vapour must be absent during processing
(1) Suitably pickle (2) Rinse; dry (3) Flux (4) Hot dip in molten alloy with agitation (5) Quench in oil (6) Wipe or tumble with sawdust *Alloys* Lead + 15–25 p.c. tin Lead + 2·5 p.c. tin + antimony, silver or zinc, in small amounts	*Thickness* (1) Strip in 0·1 p.c. antimony oxide + hydrochloric acid* (2) Strip in hot concentrated sulphuric acid (3) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method* (2) Salt-water immersion for 24 hours (3) Humidity methods* *Porosity* Ferricyanide method	(1) Antimony, silver and zinc increase the fluidity of the molten lead alloy without impairing the bending characteristics of the resultant coating (2) The coating may be soldered without recourse to an acid flux (3) Painting or lacquering is desirable for stringent conditions of exposure (4) Special fluxes are available for the application of the coating to cold-and hot-rolled sheet, malleable iron, brass and copper
Electroplating followed by heat-treatment, e.g. nickel undercoat, zinc uppercoat. Heat-treated for 6 hours at *ca.* 350° C.	*Thickness* (1) Drop and jet tests* (2) Electrical (e.g. thickness meter) or microscopic methods *Durability* (1) Salt spray method* (2) Salt-water immersion (3) Humidity methods* *Porosity* Electrographic methods	(1) Usually exhibit very good corrosion-resistance when exposed to the conditions for which the coating was designed (2) Normally thinner than hot-dipped coatings and have longer life (3) Careful surface preparation is required. Steel, for example, is alkali electrocleaned followed by anodic etching in (say) sulphuric acid (4) The uppermost metal has, normally, a lower melting-point than that of the undercoat and heat-treatment results in alloying

* Recommended test

PROTECTION

Comparative Data on Finishes

Protection	Where applicable and thickness needed	Characteristics	Advantages and disadvantages	Behaviour at high temperatures
Aluminising Calorising	High temperatures under oxidising conditions Sulphurous atmospheres 0·001–0·004 in.	Hard Abrasion-resistant Somewhat brittle Adherent	Extremely good resistance to sulphur-containing compounds	The surface does not scale on heating up to 1100° C.
Aluminium (sprayed-metallised)	Marine Industrial (painted) In contact with sulphur, crude oil, etc. 0·003–0·006 in.	Anodic to iron Fairly hard Adherent Somewhat porous Uniform	Attacked by most acids. Immune to certain strengths of sulphuric acid Attacked by most alkalis Very good resistance to sulphur-containing compounds	Good, particularly if heat-treated (see "Aluminising")
Browning process	Suitable for mild conditions	Hard Adherent Absorbent	—	Good
Bower-Barff process	Suitable for internal use in boilers and for humid conditions	Hard Adherent	—	Very good

Outline of process	Inspection and testing	Points about the process
Cementation process (1) Pickle (2) Rinse and dry (or shot-blast) (3) Spray with aluminium and heat at *ca.* 900° C.; *or* Hot dip under a suitable flux such as cryolite; *or* Heat with aluminium powder + oxide + ammonium chloride, etc.	*Thickness* Microscopic methods *Durability* (1) Salt spray method* (2) Salt-water immersion (3) Humidity methods*	(1) Alitised sections are normalised after treatment. (2) Careful surface preparation is required (3) Calorising involves hot-dipping under special fluxes or in an inert atmosphere. A brittle intermediate layer is produced (4) Aluminising is performed by spraying followed by heat-treatment which results in the diffusion of the aluminium into the basis-metal (5) Increased resistance to atmospheric corrosion may be obtained by painting
Atomised metal sprayed upon the article from a gun. Sometimes heat-treated at *ca.* 900° C. *Pre-cleaning* (1) Degrease (2) Shot-blast If a heavy coating is to be applied the profile may be roughened by mechanical means, e.g. screw cutting	*Thickness* (1) Electrical (e.g. thickness meter) (2) Microscopic methods* *Durability* (1) Salt spray method* (2) Salt-water immersion for 24 hours (3) Humidity methods* *Porosity* Electrographic methods	(1) Porosity may be minimised by a proper spraying technique (2) The use of pure aluminium is preferred. Pure aluminium coatings also protect light alloys, e.g. duralumin, in marine conditions (3) Protection is afforded at discontinuities where the base-metal has been exposed, except where very high purity aluminium has been used (4) For stringent conditions painting or enamelling is desirable (5) Porosity may be reduced by scratch-brushing the finished coating
(1) Pre-clean (2) Dip in oil or coat with tallow and heat for 30 minutes at 200°–400° C. (3) Impregnate with a suitable oil	*Durability* (1) Salt spray method (2) Humidity method*	(1) The oil finish must be constantly renewed for maximum protection (2) The introduction of sulphur into the oil used in the processing darkens the film (3) "Blueing" is also produced by heating at *ca.* 650° C. in charred sawdust or a smoky atmosphere (4) Linseed oil may be used for processing
(1) Degrease (2) Remove scale (3) Heat first in air and then in superheated steam at 800°–900° C. Finally heat in producer gas	*Thickness* Microscopic method *Durability* (1) Salt spray method* (2) Salt-water immersion* (3) Humidity method*	(1) High durability (2) May be painted or enamelled to improve its resistance to corrosion (3) Thorough precleaning and an adequate thickness are essential

* Recommended test

TABLE 1

IMMERSION ALKALINE CLEANING SOLUTIONS

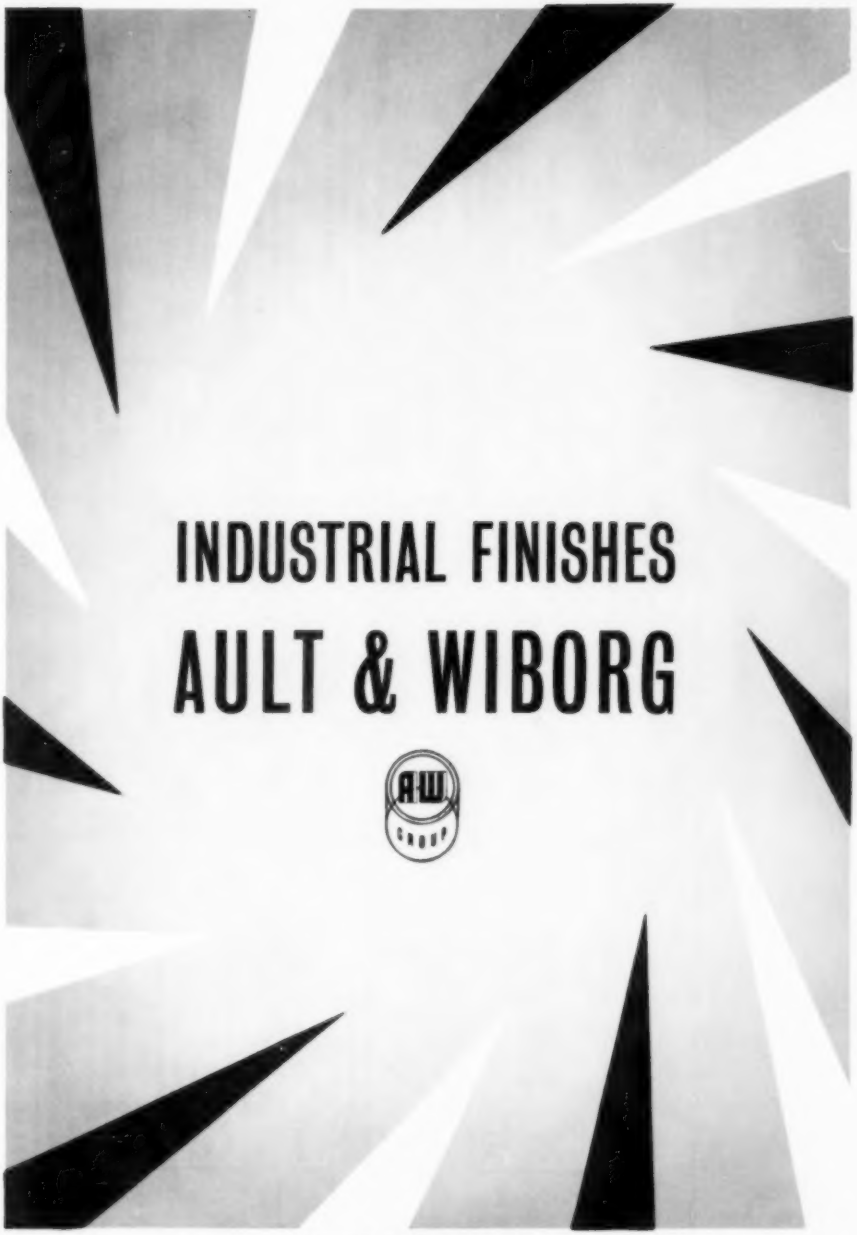
Metal	Materials/Gallon	Temperature	Remarks
Aluminium	2 oz. Trisodium phosphate ($Na_3 PO_4$, 12 H_2O) 4 oz. Sodium metasilicate ($Na_2 SiO_3$, $5H_2O$) oz. Wetting agent	180 to 200° F.	—
Brass *Medium Duty*	2 oz. Caustic soda 4 oz. Soda ash ($Na_2 CO_3$) 2 oz. Trisodium phosphate ($Na_3 PO_4$, 12 H_2O) 2 oz. Sodium metasilicate ($Na_2 SiO_3$, 5 H_2O) $\frac{1}{4}$ oz. Wetting agent	180 to 200° F.	May cause staining and bright dipping may be necessary
Light Duty	4 oz. Trisodium phosphate ($Na_3 PO_4$, 12 H_2O) 4 oz. Sodium metasilicate ($Na_2 SiO_3$, 5 H_2O) $\frac{1}{4}$ oz. Wetting agent	180 to 200° F.	Suitable for zinc base die castings, and leaves surface ready for plating. After rinsing usual to dip in Sodium Cyanide (4 oz./gallon) to remove stains
Copper	6 oz. Soda ash ($Na_2 CO)_3$ 1 oz. Caustic soda (Na OH) 2 oz. Trisodium phosphate ($Na_3 PO_4$, 12 H_2O) 2 oz. Sodium cyanide (Na CN) 1 oz. Sodium metasilicate ($Na_2 SiO_3$, 5 H_2O) $\frac{1}{4}$ oz. Wetting Agent	Room Temperature	Cold cleaner not recommended unless undesirable to heat articles or inconvenient to keep solution hot constantly
Steel *Heavy Duty*	8 oz. Caustic soda (Na OH) 4 oz. Soda ash ($Na_2 CO_3$) 1 oz. Trisodium phosphate ($Na_3 Po_4$, 12 H_2O) $\frac{1}{4}$ oz. Wetting agent OR See "Light Duty" Brass	180 to 200° F.	If used for brass may cause staining and bright dipping will be necessary
Tin	1 lb. Sodium sulphite ($Na_2 SO_3$) 5 lbs. Sodium carbonate crystals ($Na_2 CO_3$, $10H_2O$)	200° F	—
Zinc	3 oz. Sodium metasilicate 3 oz. Trisodium phosphate	200° F.	Avoid using hard water

NOTE.—*The above solutions may be used electrolytically. Aluminium and zinc, cathodically, steel, brass and copper anodically or cathodically.*

Use a voltage of about 6, and as much current as will flow. A changeover switch is useful.

Steel tanks may be used throughout.

Where possible soft water should be used for alkaline cleaners but if hard water is used sodium hexametaphosphate (Calgon) should be added to the extent of $\frac{1}{4}$ oz. per 100 gallons per degree of hardness.



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FACTORIES AT SOUTHFIELDS, WATFORD, PERIVALE, MITCHAM, MERTON, BIRMINGHAM, MANCHESTER, HULL, GLASGOW, DUBLIN

TABLE 2

ALTERNATIVE ELECTROLYTIC METAL CLEANING OPERATIONS

Metal	Typical Electrolyte (Per Gal. of Water)	Volts	Current Density Amp. Per Sq. Ft.	Temperature ° F.	Treatment Time, in Min.	Operating Data
Brass	Mild alkaline solution	7	2	200	2	Cathodic, steel anode, and tank
Brass to be nickel plated	5 oz. sodium carbonate 2½ oz. tri-sodium phosphate 14½ oz. sodium phosphate 1½ oz. caustic soda	6 to 12	high	175 to 200	Few seconds	Cathodic, steel anode, and tank
Lead or tin	5 oz. sodium carbonate and little tri-sodium phosphate	4	20 to 50	200 212	1 to 3	Cathodic, steel anode and tank, dip in HCe solution and NaCe
Magnesium	300 g. per litre chromic acid 180 g. per litre sulphuric acid	6	150 to 500	113	Few seconds	Cathodic, lead anode and tank
Magnesium	30 p.c. hydrofluoric acid	45	400	Room	10	Cathodic, lead anode and tank
Magnesium	14 oz. to 19 oz. (5 p.c. to 15 p.c.) acetic acid	4	400	Room	1 to 1	Cathodic, lead anode and tank
Magnesium	9 oz. sodium carbonate 18 oz. tri-sodium phosphate 33½ oz. caustic soda 0·24-1·2 oz. wetting agent	4	216	140 195	1 to 2	Cathodic, lead anode and tank
Nickel	2·4 oz. sodium carbonate 6 oz. sodium sesquisilicate 0·6 oz. caustic soda	6	15	210	1/12 to ½	Cathodic, lead anode and tank, follow by 2 p.c. sulphuric acid dip
Nickel	2·4 oz. sodium carbonate	6	10	120	1/12 to ½	Cathodic, lead anode and tank, follow by 2 p.c. sulphuric acid dip

Metal	Typical Electrolyte (Per Gal. of Water)	Volts	Current Density Amp. Per Sq. Ft.	Temperature ° F.	Treatment Time, in Min.	Operating Data
Steel	3·6 oz. caustic soda	6	10	145	1 to 4 anodic ½ cathodic	Agitate work, lead cathode
Steel	4·8 to 9·6 oz. caustic soda	1	20 to 60	180 200	½ up	Agitate work, lead cathode
Steel	4·8 oz. sodium carbonate 2·4 oz. tri-sodium phosphate 1·2 oz. caustic soda	6 to 12		170 to 200	½ up	Steel anode, brazed to copper bars
Steel	6 oz. sodium sesquisilicate 0·6 oz. caustic soda	6 to 12		210	1 to 5	Anodic
Zinc	0·6 oz. tri-sodium phosphate 1·5 oz. sodium carbonate	6		160 180	½ to 2	Cathodic, follow by dip in 200 g. per litre chromic acid at 212° F.
Zinc	4·8 oz. sodium cyanide 2·4 oz. caustic soda 1·2 oz. sodium dichromate	2	20 to 40		15 to 35	Use wetting agent reverse current

Cathodic cleaning is customary although often.
STEEL: Anodic cleaning preferable except in removing drawing compounds in which chlorinated hydrocarbons exist which will cause pitting.
ALUMINIUM AND ZINC are never cleaned anodically.
NICKEL PLATE is not cleaned electrolytically prior to chromium plating due to passivity created by electrolytic cleaning.
See Notes in Table 1.

TABLE 3

No attempt has been made here to include all known cleaners for metals. Instead, the aim is to provide a general list of types of cleaners and their application to some of the most common metals and metal forms. For final selection of a cleaner for a specific application, consult a reliable producer of cleaning compounds.

Method of Cleaning	Type of Cleaner	Steel, Heat Treated	Steel Stampings and Finished Parts	Cast Iron	Zinc-Base Die Castings	Aluminium	Copper	Brass	Bonderite Cleaning	Remarks
Still and Soak Tanks	Soda ash	X	X	X	—	—	—	—	X	—
	Trisodium phosphate	X	X	X	—	—	—	—	—	—
	Tetrasodium pyrophosphate	X	X	X	X	X	—	—	—	—
	Metasilicate	X	X	X	X	X	X	X	—	—
	Light-duty alkali	X	X	X	—	See Note 2		X	X	—
	Sesquisilicate	X	X	X	—	—	X	X	X	—
	Medium-duty alkali	X	X	—	—	—	X	X	—	—
	Medium-duty (non-etching) alkali	X	X	X	X	X	X	X	—	See Note 3
	Orthosilicate	X	X	X	—	—	—	—	—	—
	Heavy-duty alkali	X	X	X	—	—	—	—	—	—
	Solubilised solvent (used with kerosene)	—	X	X	X	X	—	—	—	Can be used as a dip. Rinse with clear water
	Solubilised solvent, protective type (used without kerosene)	—	X	X	—	—	—	—	—	Can be used as a dip. Rinse with clear water
Electrolytic Cleaners	Trisodium phosphate	X	X	X	X	—	—	—	—	—
	Tetrasodium pyrophosphate	X	X	X	—	—	—	—	—	—
	Light-duty alkali	X	X	X	—	—	—	—	—	—
	Metasilicate	X	X	X	X	—	X	X	—	—
	Medium-duty alkali	X	X	X	X	—	X	X	—	—
	Medium-duty (non-etching) alkali	—	X	X	X	X	X	X	—	See Note 3
	Sesquisilicate	X	X	X	—	—	—	—	—	—
	Orthosilicate	X	X	X	—	—	—	—	—	—

TABLE 3—*continued*

Method of Cleaning	Type of Cleaner	Steel, Heat Treated	Steel Stampings and Finished Parts	Cast Iron	Zinc-Base Die Castings	Aluminium	Copper	Brass	Bonderite Cleaning	Remarks
Power Washers	Soda ash	X	X	X	—	—	X	X	—	—
	Trisodium phosphate	X	X	X	—	—	X	X	—	—
	Tetrasodium pyrophosphate	X	X	X	X	X	X	X	—	—
	Light-duty alkali	X	X	X	—	X	X	X	X	—
	Medium-duty alkali	X	X	X	—	X	X	X	X	—
	Metasilicate	X	X	X	X	X	X	X	X	—
	Sesquisilicate	X	X	X	—	—	X	X	—	—
	Rag or laundry cleaner	X	X	X	—	—	X	X	—	—
	Medium-duty (non-etching) alkali	—	X	X	X	X	X	X	—	See Note 3
	Orthosilicate	X	X	X	—	—	X	X	X	—
	Solubilised solvent, non-protective type	—	—	—	—	—	—	—	X	—
	Solubilised solvent (used with kerosene)	—	X	X	X	X	X	X	—	Can be used as a dip. Rinse with clear water
	Solubilised solvent, protective type (used with kerosene)	—	X	X	—	—	—	—	—	—

Note 1—Soda ash and trisodium phosphate can be used for light-duty cleaning but the mixed cleaners are faster in action and more efficient.

Note 2—Cleaner and etch for aluminium before anodizing.

Note 3—Normal concentrations of this cleaner will only slightly etch non-ferrous metals such as aluminium, zinc and their alloys. Where no etching can be tolerated regardless of concentrations, it shall be permissible to add up to 4 p.c. sodium sulphite or other satisfactory inhibitors.

ALKALINE INDICATORS

Pн **Range and Colours**

Thymol Blue	Yellow (8·0) to Blue (9·6)
O. Cresolphthalein	Colourless (8·2) to Purple (9·8)
Phenolphthalein	Colourless (8·3) to Red (10·0)
Thymolphthalein	Colourless (9·3) to Blue (10·5)
Alizarin Yellow G	Yellow (10·1) to Orange (12·1)
Brilliant Cresyl Blue	Blue (12·0) to Yellow (12·4)
Tropaeolin O	Yellow (11·1) to Orange (12·7)

TABLE 4

FACTORS IN ALKALI METAL CLEANING

Alkali	Active Na_2O	Total Na_2O	pH Value 1 p.c. Solution at 20° C.	pH Value 10 p.c. Solution at 20° C.	Amp. Per Sq. Ft. Comparative Electrical Conductivity at 6v-4 oz. per gal. of salts		Concentration 0·38 oz. Per Gal. Grams Weight Loss Per Hr.	
					20° C.	100° C.	Tin 180° F.	Aluminum 212° F
Caustic soda	75·5	76·0	13·5	14·7	26·30	64·90	— —	{ 13·5 pH { 129·00
50 p.c. caustic and 50 p.c. metasilicate (granular)	51·5	52·6	— —	— —	16·20	41·10	— —	— —
Sodium sesquisilicate	36·5	37·9	12·7	13·5	10·10	27·30	— —	— —
Sodium metasilicate	28·0	29·2	12·5	13·3	6·58	20·40	{ 12·0 pH { 0·14	{ 12·6 pH { 0·22
Silicate of soda	18·7	19·7	12·0	13·4	3·3	11·40	— —	— —
Trisodium phosphate	10·0	18·0	12·0	12·9	3·76	15·65	{ 11·6 pH { 0·92	{ 12·0 pH { 21·9
Sodium carbonate	29·0	58·0	11·4	11·6	7·05	23·20	{ 11·2 pH { 0·79	{ 11·4 pH { 31·60
Tetrasodium pyrophosphate	8·1	23·3	10·1	10·3	3·86	12·50	— —	— —
Borax	8·4	16·3	9·2	9·3	2·12	7·55	— —	— —
(Modified soda) carbonate of soda: sodium acid carbonate	— —	— —	9·9	9·5	— —	— —	{ 10·0 pH { 0·47	— —

NOTE: *The total Na_2O is not the active Na_2O. The latter is the Na_2O available at a pH in excess of 8·3 for alkaline solutions exert little cleaning effect at a pH of less than 8·3.*

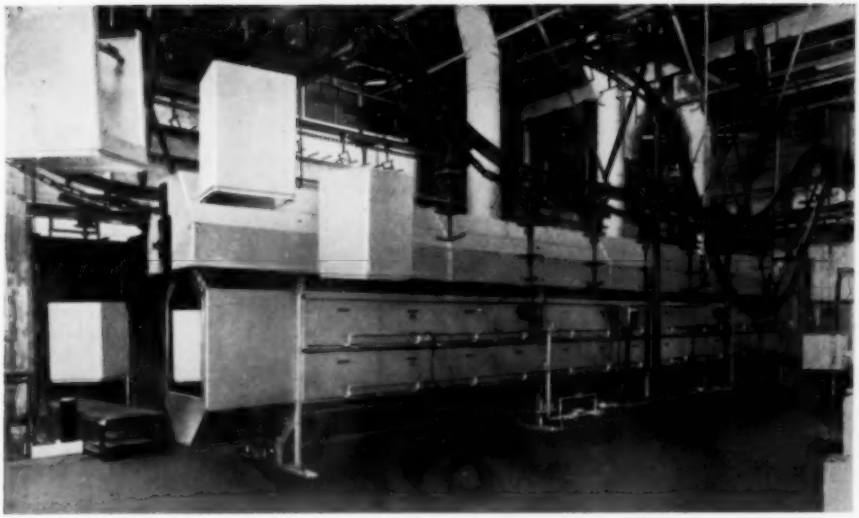

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TABLE 5

COMPARISONS OF PICKLING—DEGREASING—CLEANING PROCEDURES

Factors	Tumbling	Sand and Shot Blasting	Flame Cleaning	Safety Solvent Degreasing	Chlorinated Solvent Degreasing	Emulsifiable Solvent Degreasing	Chemical and Electro-Chemical Cleaning	Immersion and Electro-Pickling	Scratch Brushing
Equipment	Horizontal or tilting barrel—20 to 60 r.p.m.	Air blasting, etc., or centrifugal wheels	Oxyacetylene multiflame torches	Tanks and or conveying and spraying equipment	Special vapour-phase degreasing machines	Same as for safety solvents and heat	← Revolving barrels may be used (drums)	← Tanks, acid lined	Hand brushes or polishing lathes
Medium (solution or materials)	Steel balls, stars, slugs, or chemicals and soaps	Sand or grit or shot	Oxyacetylene multiflame torches	Mineral solvents with flash point over 100° F.	Trichlorethylene chlorethylene or equivaent	Mineral solvent mixed with suitable detergents, etc., followed by a hot water treatment	Generally alkaline solutions	Various acids; see pickling table 6	Hand brush-polishing lathes; see scratch brush table 10
Size and Shape Limitation	Maximum 10-lb. pieces. No interstices	Generally castings all sizes except smallest—not used after machining	No thin sections, only for large work	All shapes and sizes	Volume of small parts	All shapes and sizes	←	←	Small parts, not for production
Usual subsequent operation	Plate after pickling Painting	←	Painting	Painting or pickling or chemical cleaning, polishing, etc.	←	←	Plating Painting	Alkaline cleaning	Painting Polishing

Surface and Metal effects	Stress relief may occur. Removes dirt and scale. Dimensional changes.		Removes dirt and scale	No change to metal or surface. Removes oils, greases, and removes solid-particle dirt if loosely held.			Removes dirt, vegetable, and animal oils	Removes oxides and scale	← —
Operating temperatures	Room, Chemical barrel cleaning at elevated temperatures	Room	Extremely high temperature	Room to 250° F.	188° F. usually	Room, followed by hot water at 200° F.	Generally 140° to 200° F	Room to 180° F	Room
Health hazards	Safe	Precautions required	None	Slight	Great care required	Slight to none	Slight to considerable	Considerable	Slight
Fire Safety hazards, etc.	Safe	None	As hazardous as welding	Fairly safe	Very slight	Fairly safe	None	None	None
Type of workmen ..	Semi-skilled	Semi-skilled	Semi-skilled	Unskilled	Semi-skilled	Unskilled	Unskilled	Unskilled	Unskilled
Mechanical cleanliness—i.e. oxide and scale removed	Yes	Yes	Yes	No	No	No	No	Yes if not too heavy	Yes
Physical cleanliness—oil, grease and solid particle dirt removal ..	No	Yes	Yes	Yes	Yes	Yes	Yes, except mineral oils	No	No
Chemical cleanliness—all soils, dirt, chemicals and finger prints removed	Mostly	Mostly	No	No	No	No	Yes	No	Mostly
Subsequent oxidation ..	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes

TABLE 6

SOME SUGGESTED METAL ETCHING PROCEDURES

Metals	Baths (May be Still, Agitated or Sprayed)	Operating Temperature, °F	Volts	Current Density, Amp. per Sq. Ft.	Metal Removed per Min.	Remarks
Aluminium ..	3 parts nitric acid, 1 part hydrofluoric acid	Room	X	X	0·0005 in.	Pitch lined tank, fine etch
Aluminium ..	Tartaric acid solution, acetic acid solution or iron chloride solution	Room to 150	X	X	Up to 0·001 in.	Coarse etch, pitch lined tanks
Brass or copper	10 p.c. sodium chloride or 36 p.c. (42°Be) iron perchloride, or 10 p.c. chromic acid	Room	8 to 10	1 to 3	0·0005 to 0·001 in.	Lead or graphite anode, insulated tank. Follow by immersion in sodium stannate and cyanide solution
Nickel ..	45 p.c. (62°Be) sulphuric acid	85 to 140	8 to 10	280 to 560	0·0005 in. in 10 to 15 sec.	Ceramic tank, lead or graphite cathode
18-8 stainless steel ..	Ferric chloride solution, nitric acid solution, or ferric sulphate solution	Room	5 to 6	1 to 2	0·0005 in.	Ceramic tank, lead or graphite cathode
Steels (alloys) ..	25 p.c. by weight of sulphuric acid	Room	8 to 10	200 to 500	0·0005 to 0·001 in. in 5 min.	Ceramic tank, lead or graphite cathode

Steel ..	Ferric chloride solution, or ferric sulphate solution	Room	X	X	0·001 in.	Immersion process, coarse etch, ceramic tank
Steel ..	1 gal. 40 p.c. (42°Be) ferric chloride, 1 gal. hydrochloric acid	Room	X	X	0·0005 in.	Immersion process, fine etch, ceramic tank
Silica steel castings .	Hydrofluoric acid and hydrochloric acid	Room	X	X	0·0005 in.	Pitch or rubber-lined tank immersion process
Steel ..	10 p.c. sodium chloride solution; hot solution of 3 to 5 p.c. ferric sulphate (ferrisul), non-electrolytic also used	Room	5 to 6	1 to 2	0·001 in.	Ceramic tank, lead or graphite cathode
Zinc	5 p.c. nitric acid solution	Room	X	X	0·002 in.	Ceramic tank, immersion process
Zinc	10 to 25 p.c. copper sulphate and 20 p.c. sodium acid sulphite and 0·005 p.c. wetting agent	Room	X	X	0·0005 to 0·001 in.	Immersion process, fine etch

ETCHING RESISTS—Transfer of design by the use of steel dies and gelatin pads, or by the silk screen process, and for very large production by the lithographic (offset) method are the usual procedures. Varnish-base inks are used. The resist may be dusted over with resin and dragons blood then baked. Varnish or lacquer is applied to protect the reverse side of the metal against etching. Generally a mixture of ordinary mineral and lacquer solvents is used to remove lacquers and varnishes.

Besides prepared resists on the market the following are typical resists: (1) *9 fl. oz. of water mixed with a solution made of 8 fl. oz. of water and 1½ oz. of ammonium dichromate.* (2) *Or a resist made of the following: 250 g shellac, 20 g castor oil, 500 g methanol, 700 g propanol, 200 g isobutyl-alcohol and 4 g of caustic soda, to which solution is added a solution made of 10 p.c. ammonium dichromate, the latter to comprise 90 p.c. of the total solution. Use shortly after preparing; may not be stored.*

TABLE 7. SOME ACID PICKLING AND BRIGHT DIP TREATMENTS

Metal	Bath	Temperature, °F	Treatment Time Min.	Application
Aluminium	Nitric acid solution (10 p.c. to 50 p.c.)	Room	1 to 3	Removing smut after alkali dips
Aluminium	3 to 8 parts nitric acid and 1 part hydrofluoric acid	Room	½ to 3	Removing smut after alkali dips and brightening diecastings
Aluminium	Various proprietary acid compounds—water	At room, or elevated	1 to 3	Still baths and agitated baths for pickling and deoxidizing
High brass	9 p.c. sulphuric acid and 5 p.c. citric acid	140	2	Brightener
High brass	54 oz. sulphuric, 9 oz. nitric, ½ oz. hydrochloric acids with 60 oz. of water	Room	1 to 10	Brightener
High brass	5 p.c. sulphuric acid, followed by a dip in 10 p.c. to 15 p.c. chromic acid	140 to 150	3 to 5	Brightener
Low brass	9 p.c. sulphuric acid, 1 p.c. cream of tartar and 1 gal. of water	125	2	Brightener
Low brass		Room	1 to 6	Brightener
Chromium	18 p.c. hydrochloric acid	Room	1 to 3	Brightener
Copper and alloys	1 gal. sulphuric acid and 4 gal. water	150 to 180	1 to 60	Removal of scale
Copper and alloys	2 gal. sulphuric, 1 gal. nitric acid, 2½ lb. zinc sulphate, 1 gal. water	100	1 to 5	Excess of sulphuric "coarsens" Excess of nitric "smoothens"
Copper and alloys	2 gal. sulphuric, 1 gal. nitric acid, and 5 gal. of water	Room	1 to 10	Removal of scale
Iron	6 p.c. to 8 p.c. sulphuric and ½ p.c. hydrofluoric acid and 6½ pints of water	160 to 180	5 to 15	Removal of sand and "fire-off" scale
Iron	1·5 p.c. to 3 p.c. hydrofluoric acid, 12 p.c ferric sulphate and 6½ pints of water	160 to 180	5 to 15	Removal of sand and "fire-off" scale
Iron	20 p.c. hydrochloric and 20 p.c. hydrofluoric and 5 to 15 p.c. sulphuric acid and water	120 to 180	5 to 20	Removal of sand and "fire-off" scale
Magnesium	15 p.c. to 30 p.c. chromic acid by weight 1 p.c. sodium trifluoride	120 and higher	1 to 10	Oxide removal
Magnesium	10 p.c. to 15 p.c. chromic acid by weight ½ p.c. sulphuric acid	150	5 to 10	Oxide removal
Nickel-silvers	9 p.c. ferric sulphate, 5 p.c. adepic acid	160	1	Brightener
Nickel-silvers	2 gal. sulphuric, 1 gal. nitric, ½ gal. hydrochloric acids and 6½ pints of water	Room	1 to 2	Brightener
Nickel-silvers	2 parts sulphuric, 1 part nitric acids and small quantity of water	Room	1 to 5	Brightener
Monel	1 gal. water, ½ pint sulphuric acid, ½ lb. sodium nitrate, pinch of sodium chloride	180 to 190	30 to 90	Brightener
Monel	½ lb. cupric chloride, 1 gal. hydrochloric acid (30° Be), 13 pints water	180	20 to 40	Brightener
Monel	1 gal. sulphuric acid, 1 lb. sodium dichromate and 6½ gal. water	100	5 to 10	Follow pickle with brightener—dip in 12 p.c. nitric acid
Steel	50 p.c. sulphuric or 10 p.c. hydrochloric acid and water	70 to 90	10 to 20	Pickling 16 gauge and under
Steel	5 p.c. to 15 p.c. sulphuric or 7 p.c. to 20 p.c. hydrochloric acid	120 to 180	5 to 20	Pickling over 16 gauge steel
Steel	2 p.c. to 4 p.c. sulphuric acid, 2 p.c. to 4 p.c. ferric	160 to 180	10 to 20	Pickling light gauges

Steel	5 p.c. to 15 p.c. sulphuric or 7 p.c. to 20 p.c. hydrochloric acid	120 to 180	5 to 20	Pickling over 16 gauge steel
Steel	2 p.c. to 4 p.c. sulphuric acid, 2 p.c. to 4 p.c. ferric sulphate (ferrisul solution)	160 to 180	10 to 20	Pickling light gauges
18-8 stainless steel	6 to 8 parts sulphuric and 2 to 4 parts hydrochloric acids solution with water	140 to 160	2 to 5	Loosens scale
18-8 stainless steel	10 to 24 parts sulphuric, 1 to 4 parts hydrochloric with water	130 to 150	2 to 5	Removes scale
18-8 stainless steel	6 p.c. to 12 p.c. ferric sulphate (ferrisul) 3 p.c. to 6 p.c. hydrofluoric acid and water	160 to 180	2 to 5	Removes fire scale
Chrome stainless	10 parts sulphuric acid, 1 lb. sodium chloride and water	140 to 160	2 to 5	Loosens scale
Chrome stainless	25 parts hydrochloric and 1 lb. nitric acids, 100 parts water	140 to 160	2 to 5	Removes scale
Zinc and cadmium	6 p.c. to 12 p.c. ferric sulphate, ½ p.c. nitric, 8 p.c. to 10 p.c. sulphuric acids and acid tartarate	160 to 180	5 to 15	Brightener
Zinc and cadmium	10 p.c. nitric, 2 p.c. sulphuric acids and hydrogen peroxide	Room	1 to 10	Brightener—do not use prior to plating
Zinc and cadmium	½ p.c. to ¼ p.c. nitric acid, or 13 oz. chromic acid with 0·1 oz. hydrogen peroxide	Room	1 to 5	Brightener

TABLE 8. ELECTROLYTIC PICKLING

Metal	Electrolyte	Current Density, Amp. per Sq. Ft.	Minutes	Operation
Brass	Electrolyte same as chrome plating bath	4 to 8	1 to 3	Cathodic, room to 125° F.
Brass	10 p.c. to 20 p.c. nickel sulphate	60 to 80	——	Cathodic, 100° to 150° F.
Nickel and alloys	Sulphuric and phosphoric acids and water, varying concentrations	Varying	5 to 15	Anodic at varying temperatures (brightener)
Nickel-silvers	10 p.c. to 20 p.c. sulphuric acid	Varying	1 to 10	Reverse current, varying temperatures and follow with dip in sodium cyanide solution
Non-ferrous alloys	Ammonium citrate or 5 p.c. sodium cyanide	5 to 10	30 sec.	Anodic, room to 125° F. prior to regular pickling for scouring
Ferrous alloys	75 p.c. to 80 p.c. sulphuric acid	1 to 10	1	Anodic, room temperature (brightener)
Steel	Bullard-Dunn processes: 10 oz. sulphuric acid, 0·13 oz. tin sulphate, 6½ pints water	30 to 80	1 to 10	Cathodic
Steel and iron	Ferrous sulphate (0·4N $FeSO_4$) and 0·3 p.c. sulphuric acid	8	30	Anodic (brightener)
Steel and iron	Sulphuric acid 47·5 g. per litre, 10·3 g. per litre hydrochloric acid, sodium chloride 22·5 g. per litre, little lead sulphate, and litre H_2O	75	3 to 5	Cathodic (Duriron anode) 150° to 180° F.
High-speed steels	115 g. per litre caustic, 15 g. per litre citric acid, then dip in 6 to 12 normal hydrochloric few seconds	25	1 to 5	Anodic, room temperature (brightener)

TABLE 9

POLISHING DATA

Metal	Polishing Grit Size	Type of Wheel	Result
Aluminium	Pumice grease compound	Tampico, or horse hair	Satin or brushed finish; very little cutting down
Aluminium	Rouge	Loose, or spiral sewed	Mirror
Aluminium	Grease stick	Loose, or spiral sewed	Mirror
Aluminium	(Slow medium buff) tripoli 20–70	Loose, or full disc	Satin to mirror
Aluminium	Tripoli 12–70	Loose, or full disc	Satin to mirror
Brass	Lime soap or white lime	Sheepskin, felt or spiral sewed	Clear brilliant surface
Brass	Grease stick	Loose, or spiral sewed	Mirror
Brass	Tripoli 70	Full disc, or loose buff	Satin to mirror
Brass	Tripoli 70–100	Full disc, or loose buff	Satin to mirror
Brass	Pumice grease compound	Tampico, or horse hair	Satin or brushed finish; very little cutting down
Bronze	Tripoli 70	Full disc, or loose buff	High polish, easily rinsed
Cadmium	White colouring compound	Sewed canvas	Satin; use tripoli to buff or colour
Cadmium	Pumice grease compound	Tampico or horse hair	Satin or brushed finish; very little cutting down
Cadmium	Grease stick	Loose, or spiral wheel	Mirror
Cadmium	Rouge	Loose, or spiral wheel	Mirror
Cadmium	Lime soap or white lime	Sheepskin, felt, or spiral sewed	Clear brilliant surface
Copper plate	Lime soap or white lime	Sheepskin, felt, or spiral sewed	Clear brilliant surface
Copper	Grease stick	Loose, or spiral sewed	Mirror
Copper	Pumice grease compound	Tampico, or horse hair	Satin or brushed finish; very little cutting down
Nickel plate	180–240 grit		Satin to mirror
Nickel plate	Lime soap or white lime	Sheepskin, felt, or spiral sewed	Clear brilliant surface
Nickel silver	100 grit	Full disc, or loose buff	High polish, easily rinsed
Silver	Tripoli 3–12 and crocus 100	Full disc, or loose buff	Satin, mirror, then high polish
Steel	Crocus, 10,000 ft. min.	Loose, or spiral sewed	Mirror finish, easily cleaned and rinsed
Steel, Gear deburring		Tampico, or wire wheel	Cutting down and deburring
Steel, stainless	Rouge	Loose, or spiral sewed	Mirror
Steel, stainless	Tallow, No. 1 operation 180 Al_2O_3	14-in. wheel, 1600 to 2600 r.p.m.	Satin polish
Steel, stainless	Tallow No. 2 operation 220 emery	14-in. wheel, 1600 to 2600 r.p.m.	Satin polish
Steel, stainless	Dry compound	Revolve wheel in opposite direction of polishing, 16 in. hard wheel	Mirror. Finish 2800 to 3000 r.p.m.

(*Continued over*

Metal	Polishing Grit Size	Type of Wheel	Result
Steel, stainless	Artificial flour mixed with grease	Loose, or spiral sewed	Satin, removes wheel marks
Steel, stainless	36 grit rubber bonded		
Zinc die casting	Greaseless, glue and cement, 180 grain	Solid, or build-up canvas felt or leather	Bright to semi-bright
Zinc die casting	Grease, stick-stearic acid or tallow, (etc.)	Loose or sewed pocket buff, or 18 to 20 ply pieced buff	To obtain mirror finish buff with No. 220 grain
Zinc die casting	Greaseless	Full disc, loose or set-up wheel, 12 in. to 18 in., wheel 8500 r.p.m.	High quality colouring
Zinc die casting	(Slow medium) tripoli 20	Full disc, loose or set-up wheel	Satin or mirror
Zinc die casting	Automatic tripoli 14	Full disc, loose or set-up wheel	Satin or mirror
Tin	Lime soap or white lime	Sheepskin, felt or spiral sewed	High polish, easily cleaned and rinsed

In general polishing speeds approximate 6500 f.p.m. with final finishing or buffing operating at higher speeds of around 10,000 f.p.m. Initial polishing or cutting-down is effected with emery or tripoli generally, and final finishing with direction of finishing in opposite direction to polishing. Final finishing is done with such material as rouge (on precious metals), crocus for tin and iron, lime for nickel and copper alloys, chrome oxide for chrome plate, etc.

Emery grit is sized 6-200 mesh and finer.

In connection with buffing, some metal is lost which must be kept in mind when buffing plated goods; for instance, 20 p.c. of the metal is lost in buffing nickel plate.

Buffing anodized and dyed aluminium removes approximately 0·00017 in., using rag buffs at 7500 to 9700 f.p.m. Flannel may be used for colour buffing of gold, sand and oil hobbing (not emery) for silver, polishing at 6500 to 10,000 f. p.m.

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TABLE 10

SCRATCH BRUSH OPERATIONS FOR THE REMOVAL OF BURRS AND SCALE

Factors	Pipe Ends ID	Steel Tubes	Sheet Metal	Aluminium Castings	Aluminium (Rough), Coarse Finishing	Aluminium, Fine Finishing
Wire size	0·14 in.	0·14 in.	0·095 in.	0·08 to 0·0118 in.	0·015 in.	0·002 to 0·005 in.
Wheel size	Small	8 in.	8 in.	2 to 12 in.	12 in.	12 in.
Arbor hole	¾ in.	1¼ in.	½ in.	¼ to ½ in.	6 in.	6 in. or smaller
R.p.m.	20,000 f.p.m.	30,000	3000	1750	1750	450 to 700
Operation	Deburring	Deburring	Deburring	Deburring	Cutting-down	Smoothing

For scratch-brushing aluminium and brass use soft brass wire with lanolin emulsion or soluble oil as a lubricant; for zinc and cadmium use scratch brush with 0·003 to 0·009 in. wire at 3000 to 6000 r.p.m. Steel wire presents more lustrous finishes on aluminium than does brass wire.

OPERATION SCHEDULES—EMERY ABRASIVE

Steel Stampings and Malleable Iron Castings

First-Class Polishing

1st Operation	Roughing	70 emery
2nd ,,	Fining	120
3rd ,,	Second Fining	180
4th ,,	Greasing	180
5th ,,	Flouring	Flour

Second-Class Polishing

1st Operation	Roughing	70 emery
2nd ,,	Fining	120
3rd ,,	Greasing	120
4th ,,	Finishing	180

Third-Class Polishing

1st Operation	Roughing	70 emery
2nd ,,	Fining	120
3rd ,,	Greasing	120

Mild Steel Pressings and Non-Ferrous Metals

Second-Class Polishing

1st Operation	Roughing	120 emery
2nd ,,	Greasing	120
3rd ,,	Mopping	Tripoli compo
4th ,,	Colouring off	Vienna lime

Second-Class Polishing

1st Operation	Greasing	120 emery
2nd ,,	Mopping	Tripoli compo
3rd ,,	Colouring off	Vienna lime

TABLE 11

TYPICAL POLISHING WHEEL GRIT SIZES

Grit	Aluminium Die Castings	Aluminium Sand Castings	Aluminium Sheet	Brass Castings	Brass Sheets etc.	Cutlery	Gray Iron	Knives	Monel Cast and Drawn	Monel Sheet	Enamel Stock	Stainless Steel Mirror	Commercial Steel	Zinc
Al_2O_3	150	36 to 46 60 to 80	120	60 to 80	180 to 220	80	70	80 to 90	80 to 120	180	90	60 to 80	80	180
Al_2O_3	X	120 to 180	180	150 to 180	Buff	120	120	120 to 150	120 to 150	X	100	120	100	220
Al_2O_3	X	X	Buff	220	X	X	150	220	150 to 180	X	120	150	120	X
Al_2O_3	X	X	X	X	X	X	240	X	Buff	X	150	Buff	180	X

TABLE 12

COMPARATIVE FRICTIONAL PROPERTIES OF METAL SURFACES

Frictional Factors	Chromium Plate on Chromium Plate	Babbitt on Chromium	Steel on Chromium	Iron on Iron	Nickel on Nickel	Copper on Copper	Babbitt on Babbitt	Steel on Steel	Steel on Babbitt
Coefficient of friction (sliding) ..	0·12	0·13	0·16	0·17	0·18	0·18	0·19	0·20	0·20
Static friction	—	—	29	—	—	—	100	55	44

It is to be noted that chromium surfaces have approximately one-third less friction than other surfaces.

TABLE 13

OPERATIONS COMPARISON OF POLISHING AND BUFFING WHEELS

Factor	Spiral Sewed	Concentric Sewed	Square Sewed	Sewed and Pieced	Woven Cloth	Soft Canvas	Walrus Hide	Sheepskin, Felt, Irregular Shapes	Full Sewed Disc
Operation	More effective in cutting-down than disc wheels	More uniform results than with spiral-sewed wheels	For heavy cutting-down	For cutting down low cost wheel	Polishing brass, stainless, aluminium bronze and rough steel castings	For heavy aluminium and brass	Polishing cutlery, silverware, High-carbon steels	Fine buffing of flatware, cutlery, etc.	Performance almost equal to spiral-sewed in effectiveness of cutting-down

Leather-covered wood wheels perform like grinding operations.
Walrus leather disc, full disc sheepskin for brass, steel cutlery.
Canvas disc, coarse abrasive polishing-out on castings, forgings and brass plumbing.
Cloth or canvas most used and most versatile for roughing-out to finishing.

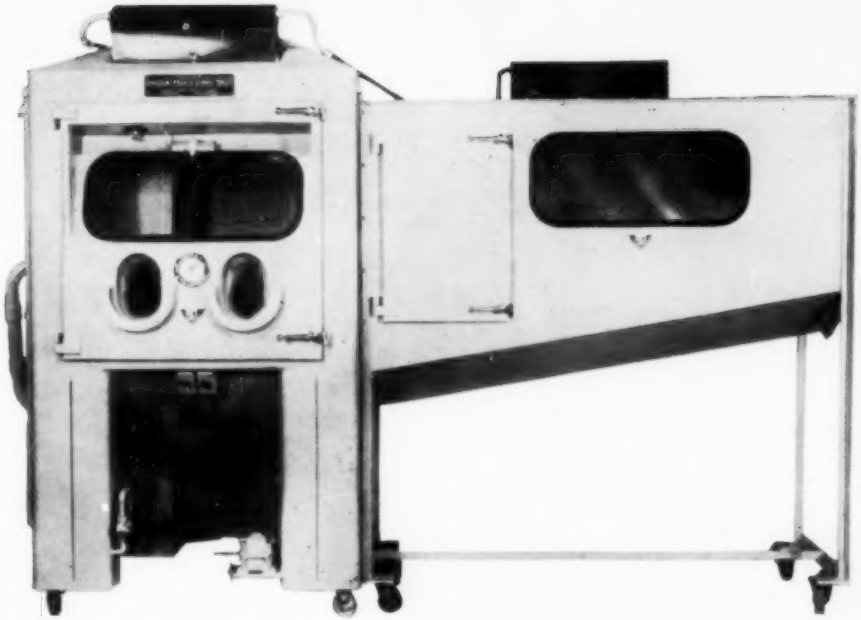

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TABLE 14

BARRELLING DATA

Factors	Tumbling	Deburring	Rolling	Burnishing
Operation	Cutting-down	Selective cutting-down	Polishing and light cutting-down	Buffing
Equivalent wheel or manual operation	Grinding and snagging	Grinding and filing	Polishing	Buffing
Work	Castings and forgings	Castings and forgings and machine-screw products	Castings, forgings, stampings, and screw-machine products	← —
Size limitation	Longest dimensions NOT over 6 in., with exception of rods			
Shape limitation	Work with sharp edges or thin cross-sections or interlocking parts, and hollow and drilled sections present difficulties			
Dimensional changes	Considerable	Less than in tumbling	Some cutting-down, but to a controllable degree	Not appreciable
Surface appearance	Even	Even	Smooth	Lustrous
Effect on metal	Tends to neutralize strains	None	None	None
Other effects on surface	Removes skin, scale, burrs, fins, corners, etc.	Removes burrs	Removes flash, wire-edges, pits, rough spots rust and light burrs, and round corners	Closes pores
Medium	Annealed metal slugs, stars, jacks, punchings	None	Metal tacks, slugs, steel balls, steel wool. Softer working medium used than in burnishing	*Self burnishing or hardened steel balls or odd shapes.

Abrasive	With or without pumice, slag, chips, sand, etc.	Granite or other equivalents	Cinders, slugs, sand, alundum, emery, carborundum, pumice. For brass and aluminium—Crocus lime, chalk, meal, pumice, felt, maple, lignum vitae, etc.	None
Dry operation	Sometimes	No	Screw-machine products in dry, fine sawdust for brightening	No
Wet operation	Usual	Solvent soap type of lubricants	Content of water regulates extent of cutting-down action	Carefully selected lubricant or soap
Chemicals	Oxalic acid or cyanides aid the removal of scale	Proprietary compounds	Sulphuric or hydrochloric acid for removal of scale. To improve the colour of steel use tartaric acid or a cyanide; sodium silicate may be added for soft metal	No, though with brass a cyanide solution may be added
Operation on light metals	———	Low r.p.m.	Fine, soft abrasives with plenty of water. Low r.p.m. Fine, dry polish for soft metals 6 in. vegetable ivory	Small balls, low r.p.m., 30 to 40 average r.p.m.
Operation on heavy metals	———	Higher r.p.m.	Coarser and harder abrasives and with less water and greater r.p.m. than with light metals	Coarser balls and higher r.p.m., 40 to 60 r.p.m.
Type of Barrel	Horizontal	Horizontal	Open-end tilting for small parts; horizontal may be used	Horizontal (small)
Time of operation	1 to 10 hr.	2 to 24 hr.	Aluminium, 1 to 20 hr.; brass and bronze, 1 to 15 hr.; malleable castings, 30 to 40 hr.; grey iron, 70 to 80 hr.; hot-rolled steel, 50 hr.; stampings, 10 to 100 hr.	20 min. to 10 hr. (silver 20 min.)

• *Burnishing balls are force-dried and treated with a rust preventive to inhibit rust formation when not in operation.*

One difficulty in barrel operations is in keeping the abrasive materials in working suspension. Greater efficiency and shorter cycles may be obtained when a proprietary material is used to aid in the suspension of the abrasives. Abrasives which remain at the periphery of the barrel do little work and are short-lived. This material also prevents the metal media from rusting between operations.

Overloading of the barrel is one of the major sins in barrel operations, even worse than excessively high speed.

Barrel polishing or burnishing in high and narrow barrels closes the pores of the plated metal and helps eliminate spotting-out to even a greater extent than alternate hot- and cold-water dips do, following certain plating solutions.

TABLE 15—ELECTROPOLISHING SOLUTIONS

Metal	Bath Type	Patent No.	Conditions		Claim	Inventor	Assignee
			Amps/sq. ft.	°F.			
Stainless Steel	Conc. sulphuric acid ..	U.S. 2,379,066	864 to 1728	86 to 122	Method ..	I. C. Clingan ..	Rustless Iron & Steel Corp.
,,	ditto.	Can. 422,922	ditto.	ditto.	ditto. ..	ditto.	ditto.
,,	Chromic acid	U.S. 1,961,752	50	40	Process : article ..	C. G. Fink F. J. Kenny	
,,	Phosphoric acid	U.S. 1,658,222	100	122	Method ..	R. W. Burns C. W. Warner	
,,	Perchloric acid	Can. 404,427	30 to 1440	30 to 160	ditto. ..	I. C. Clingan ..	ditto.
,,	Nitric acid	Fr. 852,312	700	50		Bergman, Erikson, Frey, and Hildebrand	
		Brit. 530,041		50 to 104		ditto.	
,,	Sulphuric-phosphoric acid	U.S. 2,334,698	> 30	80 to 280	Article : method : electrolyte	C. L. Faust ..	Battelle Memorial Institute
,,	ditto.	Brit. 526,854	ditto.	ditto.	ditto. ..	—	ditto.
,,	Sulphuric-phosphoric-glycine	U.S. 2,348,517	430 to 570	160	Method ..	G. J. Beckwith ..	American Steel & Wire Co.
,,	Sulphuric-phosphoric-fluorescine-alcohol	U.S. 2,349,843	430	140 to 160	Process : electrolyte	ditto.	ditto.
,,	Sulphuric acid-glycerine ..	Ger. 682,248	465	130	Process ..	Hans Burkhardt	
,,	Sulphuric-citric acid ..	U.S. 2,335,354	72 to 216	122 to 250		J. N. Ostrofsky ..	Rustless Iron & Steel Corp.
,,	ditto	Brit. 529,944				Alloy Research Corp.	
,,	ditto. and alcohol	U.S. 2,331,721	72 to 316	ditto.	Method : electrolyte	J. N. Ostrofsky ..	ditto.
,,	Sulphuric-hydrofluoric ..	U.S. 2,115,005	250 or higher	Not given	Method : pickling bath ..	Blaut and H. Lang	
,,	ditto.	Brit. 517,415				ditto.	
,,	ditto.	Fr. 837,126				ditto.	
,,	Phosphoric-chromic ..	U.S. 2,366,712	100 to 1000	80 to 175	Method ..	C. L. Faust ..	Battelle Memorial Institute
,,	Chromic + acetic or formic	U.S. 2,381,167	150 to 350	90 or less	ditto. ..	C. R. Hornwedel and W. J. Resch ..	American Steel & Wire Co.
,,	Nitric-hydrofluoric-hydrochloric acid	U.S. 2,357,219	None	180 to 200	Article : electrolyte : method ..	N. S. Mott ..	J. P. Moran

TABLE 15—*continued*

Metal	Bath Type	Patent No.	Conditions		Claim	Inventor	Assignee
			Amps/sq. ft.	°F.			
Metals (steel)	General	Can. 421,495			Method for increasing fatigue resistance	S. C. Avalone ..	American Steel & Wire Co.
Metals (Ni, Pb, Al)	Phosphoric or perchloric Acetic-perchloric	Fr. 707,526	360	70 to 140	Solution ..	Société dite: Le	Materiel Telephonique
Brass, Zinc Copper	Phosphoric-chromic	Pat. appl.				C. L. Faust ..	Battelle Memorial Institute
	Chromic-sulphuric-acetic	U.S. 2,330,170	200 to 3000	50 to 167	Method ..	R. W. Manuel ..	Crane Co.
Copper	Phosphoric + aluminium ..	U.S. 2,366,714	50 to 250	100 to 170	Method: electrolyte	C. L. Faust ..	Battelle Memorial Institute
		Brit. 558,726					
,,	Phosphoric-chromic ..	U.S. 2,347,039	100 to 1000	60 to 170	Method ..	ditto.	ditto.
,,	Sulphuric-phosphoric-chromic	Swed. 107,792	ditto.	ditto.	Method: electrolyte	ditto.	ditto.
,,	Phosphoric acid	Swiss 187,439	ditto.	ditto.		P. A. Jacquet ..	
Zinc	Phosphoric-chromic ..	U.S. 2,373,466	4 to 100	60 to 100	Method ..	C. L. Faust ..	Battelle Memorial Institute
	50° Bé zinc chloride ..	Ger. 302,902	1000	60	ditto. ..	Hans Strecker	
Silver	Alkaline-cyanide	Ger. 225,873	9	Room	Article: process ..	E. Spitalsky	
Molybdenum	Sulphuric acid	Fr. 707,526	360	70 to 140	Solution ..	Société dite: Le	Materiel Telephonique
Nickel	ditto.	U.S. 2,145,518	280 to 560	85 to 140	Method ..	E. E. Lindl Elektrochemie aktiebolaget	
,,	ditto.	Ger. 645,979	ditto.	ditto.	ditto. ..	ditto.	
,,	Sulphuric-phosphoric ..	U.S. 2,334,699	50 to 250	80 to 220	Method: electrolyte	C. L. Faust ..	Battelle Memorial Institute
,,	ditto. + aluminium	Brit. 558,727	ditto.	ditto.	Method: composition	ditto.	ditto.
,,	,,	Can. 431,775	ditto.	ditto.	ditto. ..	ditto.	ditto.
,,	Phosphoric-chromic ..	U.S. 2,366,713	125 to 250	100 to 155	Method ..	ditto.	ditto.
Aluminium	Fluoborate	U.S. 2,108,603	10 to 80	86 to 91	Method: process	R. B. Mason ..	Aluminium Co. of America

TABLE 15—*continued*

Metal	Bath Type	Patent No.	Conditions		Claim	Inventor	Assignee
			Amps/sq. ft.	°F.			
Stainless Steel	Hydrochloric-sulphuric-nitric acid + titanium	U.S. 2,172,421	None	160 to 175	Article : method : bath ..	H. H. Uhlig ..	The Chemical Foundation, Inc
,,	Hydrochloric-sulphuric-titanium chloride	U.S. 2,172,428	None	ditto.	Article : method ..	John C. Wulff and H. H. Uhlig ..	ditto.
Metals	Pyrophosphoric-alcohol .	U.S. 2,294,227	280	68	Method .	R. P. Delaplace and C. L. Bechard ..	Société Brevets Aero-Mecaniques
		Fr. 850,135				ditto.	
		Brit. 524,272			Process .	ditto.	
,, (steel)	Phosphoric-chromic	U.S. 2,347,040	100 to 500	100 to 255	Method .	C. L. Faust ..	Battelle Memorial Institute
,, (ferrous)	Sulphuric-phosphoric	U.S. 2,334,699			Method : electrolyte	ditto.	ditto.
		Brit. 526,854			ditto. ..		ditto.
,, (steel)	dittochromic	U.S. 2,338,321	100 to 1000	80 to 280	Method .	ditto.	ditto.
,,	Sulphuric-arsenic	Swed. 107,601			ditto.	ditto.	ditto.
		U.S. 2,282,350	50 to 1000	120 to 160	Method : electrolyte	ditto.	ditto.
,,	ditto.	Brit. 552,638			ditto. ..		ditto.
,,	Sulphuric + phosphoric + chromic	U.S. 2,282,351	50 to 1000	120 to 160	ditto. ..	ditto.	ditto.
,,	Sulphuric-phosphoric-lactic	U.S. 2,386,078	72 to 288	160 to 200	Electrolyte	S. Weisberg and I. Levin	Seal Test, Inc.
,,	Hydrochloric-formic Nitric-formic	Fr. 852,312	930	50 to 104	Method ..	Bergman, Erikson, Frey, and Hildebrand	
,,	Sulphuric-Glycerine ..	U.S. 2,315,695	300 to 1000	80 to 200	ditto. ..	C. L. Faust ..	Battelle Memorial Institute
,	Sulphuric-phosphoric-glycerine	U.S. 2,315,695	ditto.	ditto.	ditto. ..	ditto.	ditto.
,,	Sulphuric-phosphoric-perchloric	U.S. 2,315,696	50 or higher 14	70 to 212	Method: .. electrolyte	ditto.	ditto.
,,	Hydrochloric-glycol ..	U.S. 2,382,549			Process ..	R. W. Edmunson ..	National Cash Register Co.

TABLE 15—*continued*

Metal	Bath Type	Patent No.	Conditions		Claim	Inventor	Assignee
			Amps/sq. ft.	°F.			
Aluminium	Fluoborate	U.S. 2,108,604	10 to 80	86 to 91	Article ..	R. B. Mason ..	Aluminium Co. of America
,,	Fluoboric acid	U.S. 2,153,060	10 to 20	160 to 205	Process : method	J. M. Guthrie ..	ditto.
,,	Hydrofluoric-sulphuric	Brit. 436,154	10 to 100	85 to 160		R. B. Mason and M. Tosterud ..	ditto.
,,	Hydrofluoric-chromic ..	Brit. 436,481	None	None		ditto.	ditto.
		Can. 354,511	None	None		ditto.	ditto.
,,	Hydrofluoric-glycerine ..	U.S. 2,375,394	50 to 450	77	Method ..	M. Tosterud ..	ditto.
,,	Fluoboric + ($AcOH + BF_4$)	Brit. 433,484				R. B. Mason ..	ditto.
,,	Hydrofluosilicic	Can. 432,347	10	150	ditto. ..	G. Kraft and N. L. Soloman	
,,	Sulphuric-phosphoric-acetic-boric	Brit. 447,420	3 to 4	175 to 195	Process ..	C. H. R. Gower and F. Windsor-Bowen	
,,	Sulphuric-phosphoric-nitric	Fr. 798,721				Tré fileries et lam	inoirs du Havre
,,	Sulphuric-phosphoric ..	Pat. appl.	100 to 150	140 to 200		C. L. Faust ..	Battelle Memorial Institute
,,	Sulphuric-gallic-boric ..	Brit. 447,42?	None	None		C. H. R. Gower and E. Windsor-Bowen	
,,	Chromate-carbonate .	Ger. 675,273	14 to 144	160 to 195	Electrolyte	J. M. Guthrie ..	Aluminium Co. of America
,,	None given	U.S. 2,324,106	None given		Article ..	R. E. Petit	ditto.
,,	Phosphoric-glycerine ..	Can. 423,091	None	120 to 200	Method ..	M. Tosterud ..	ditto.
,,	Phosphoric-glycol	Can. 423,093	None	70 to 212	ditto. ..	O. Leroy	ditto.
Apparatus	Chromic-sulphuric-phosphoric	U.S. 2,378,002	200 to 500	150	Apparatus ..	F. E. Drummond and D. E Bench	The Himmel Bros. Co.
,,		U.S. 2,349,908	None	None	A holder ..	R. R. La Motte ..	International Harvester Co.
,,	Sulphuric-hydrofluoric or phosphoric	U.S. 2,390,282	None	None	Barrel ..	S. Tour and A. E. Howe .. .	S. Tour.

ELECTROPLATING

PLATING BATHS— FAULTY DEPOSITS AND CORRECTION

Key to Table 16

1.—Decrease the current density.

2.—Increase the current density.

3.—Decrease the temperature of the bath.

4.—Increase the temperature of the bath.

5.—Continuous filtration is recommended. (Decreases throwing power slightly.)

6.—Settle and decant the impurities.

7.—Solution agitation is recommended.

8.—A better throwing power results from a still bath.

9.—Increase the anode-to-cathode distance.

10.—Regulate the anode-to-cathode ratio.

11.—Remove the anodes from the bath when *not* in operation.

12.—Decrease the hydrogen occlusions and subsequent metal embrittlement either by operation at higher temperatures when other conditions permit, or by baking the plated metal at about 350° F. to 400° F. for 1 hr. to 4 hr. Deposited silver is the most difficult to relieve of hydrogen occlusions; chromium has the greatest amount, lead the least, while tin is the easiest to relieve; cadmium has a negligible amount, while zinc has considerable. Baking in air is more efficient in hydrogen relief than an immersion in hot oil.

13 –Correct racking is very important.

14.—Conforming anodes and insulated baffle plates are requirements in much of this type of plating.

15.—Polish the base metal prior to plating.

16.—Bag the anodes.

17.—Agitate the cathodes (work), and if the throwing power is lost, counterbalance by using a more concentrated electrolyte or a higher current density, or increase the conducting salt contents.

18.—The temperature control is delicate.

19.—Exact control of temperature and current density are requirements: In the chromium bath, for instance, at 122° F. a 200 amps. per sq. ft. density is about correct while at 113° F. a current density of 100 amps. per sq. ft. is correct. Too low current density gives matte and too high also gives a matt finish.

20.—Operation at correct *p*H range is a necessity.

21.—Copper, tin or nickel in the order named is the best undercoat for silver plate.

22.—At least a flash coat of copper from an alkaline bath is necessary for best results prior to entering the acid copper bath.

23.—A high sulphate nickel bath, or one of the proprietary nickel baths is required if a zinc diecasting is to be plated directly with nickel.

24.—Add (325 mesh) zinc dust, 19 oz. per 100 gall. of electrolyte, or cadmium sponge, and stir for about 1 hr. or more and filter to remove metallic impurities; or electrolyse at a low current density (2-3 amps. per sq. ft.) at room temperature, and filter.

25.—Precipitate iron from nickel baths with iron filings or iron hydroxide at a *p*H of 5·5; or add sodium sulphide or sodium thiosulphate.

26.—Remove metallic impurities, e.g. copper, lead, cadmium, iron, zinc, aluminium, chromium, etc., from hard nickel and chloride nickel baths as follows:

a.—Remove anodes from bath or use a separate bath.

b.—Raise the temperature of the bath to about 140° F.

c.—Add nickel carbonate slurry and stir until *p*H is about 5·6 to 5·8.

d.—Stir in 2 to 4 lb. of lime per 100 gall. of electrolyte until *p*H is about 6·0 to 6·2.

e.—Add hydrogen peroxide, 9½ oz. per 100 gall. of electrolyte, stir and filter through activated carbon.

27.—Remove tin from brass baths with a solution of calcium chloride, stir and filter.

28.—Remove organics by filtering, or add hydrogen peroxide, stir and filter through activated carbon or diatomaceous earth, etc. In bright-nickel baths

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this method cannot be used unless the baths can be replenished with the brighteners.

29.—Use mechanical agitation *not* air agitation.

30.—Reduce hexavalent to tri-valent chromium by electrolysing at very low current density (2 to 2 amps. per sq. ft.) and use a much smaller cathode than anode.

31.—Increase the dextrin content.

32.—Decrease the caustic soda, acetate and hydrogen peroxide contents to avoid sponginess.

33.—Increase the caustic soda contents.

34.—Lower the *p*H.

35.—Raise the *p*H in nickel baths; boric acid is used as a buffer to assist in maintaining *p*H.

36.—Reduce the cyanide contents; excessive cyanide causes blisters in cyanide plating baths. Excessive cyanide may be indicated by undue gassing and little deposition, and may be corrected by adding metal carbonate.

37.—Increase the cyanide contents. Add 5 lb. of cyanide per 1,000 sq. ft. of plated work in brass bath.

38.—Reduce the metal contents; in the silver bath do not use over 33 g. per litre of silver.

39.—Increase the metal contents.

40.—Decrease the carbonate contents, excessive carbonate is precipitated out of copper and cadmium cyanide and other cyanide baths with calcium sulphate or by freezing; 1·6 times as much calcium sulphate is added as carbonate to be precipitated. Add the sulphate, stir and filter. In freezing use a steel container holding 32 gal. of naphtha and 1,400 lb. of dry ice.

41.—Increase the carbonate contents.

42.—Multi-edge anodes of lead tend to give improved conductivity in chromium baths.

43.—High sulphate ratio in chromium baths narrows the bright range and decreases the coverage.

44.—Decrease the brightener contents.

45.—Increase the brightener contents.

46.—Requires silver strike deposit prior to entering a standard electrolyte.

47.—Decrease the hydrogen peroxide contents.

48.—Add hydrogen peroxide.

49.—Reduce the amount of conducting salts.

50.—Increase the amount of conducting salts.

51.—To reactivate a nickel deposit after the chromium plate has been stripped, use an 18 per cent. HCl acid immersion and clean in reverse current in the chromium plating bath before plating.

52.—Increase the buffer agent content.

53.—Use less than 33 g. per litre of silver bath to avoid smutty deposits, or if a high silver content exists along with high current density, a burnt deposit will occur.

54.—Bath should be kept full of work, or dummy cathodes should be used and then utilised as anodes as they become covered with metal.

55.—Add glue to increase the throwing power and to brighten the deposit in the Rochelle bath.

56.—Decrease the glue contents.

57.—Use potassium salts in place of sodium salts.

58.—Use more wetting agent.

59.—Operate with pure salts.

60.—Thorough cleaning is imperative.

61.—Iron compounds are very difficult to remove from Rochelle copper baths, so use a minimum amount of carbonate.

62.—In low *p*H nickel baths, use a range of 1·5 to 3·0 *p*H, and for high *p*H baths, do not operate in any range but 3·6 to 4·5. Low *p*H baths present smooth deposits at high current densities, while the high *p*H baths give rough deposits when operated at high current densities.

63.—Remove excess carbonates from brass baths with barium cyanide, stir, filter, or freeze and filter.

64.—A film on the anode indicates a need for increased cyanide contents. (1) If a steel-grey deposit occurs it indicates arsenic; remove by using a copper cathode and plate out. (2) A black film on the anode which persists when the current is off may be lead in the bath, which may be electrolysed out at low current densities. (3) Tin is indicated by a dark film on the anode which disappears when the current is off; this may be removed by electrolysing at low current densities, or by precipitating out with calcium chloride, stirring and filtering. Loose dark films, cupric oxide, offers no harm.

65.—Add alum, 1 to ¼ oz. per gall. of electrolyte, as a brightener to brass baths.

66.—Add 1/64 oz. (per 100 gall.) of sodium hydrosulphide, or electrolyse to remove chromium from copper, cadmium and other cyanide baths, and filter.

67.—Remove excess zinc (also bronze) with sodium sulphide, stir and filter.

68.—Close temperature control of brass baths and proper composition of anodes are required to control the colour of the deposit. Increase the *p*H to increase the ratio of zinc deposited. Add sodium carbonate to decrease the ratio of the zinc deposited. (Ammonium hydroxide is added to increase the ratio of zinc deposited.)

69.—If a tray of iron or nickel gauze is immersed during cooling of the bath, an excess of carbonate can be removed from the tin stannate bath.

70.—Remove an excess of sulphate from the nickel sulphate bath by precipitating with freshly precipitated barium hydroxide, stir and filter. The same procedure is used for removing excess H_2SO_4 from chromium plating baths; use 3·13 oz. of salt per oz. of acid, although an excess may be used.

71.—Close *p*H control.

72.—Control *p*H for colour of deposit.

73.—Chloride contents of hard nickel baths to be at least 2·4 oz. per gall. to obtain good adhesion. Stresses in basis metal also may be cause of poor adherence.

74.—Add 5 oz. of potassium permanganate per 100 gall. of electrolyte, heat and filter in order to precipitate organics from the acid copper bath.

75.—Cadmium is absorbed and therefore unsuitable as an undercoat for silver.

76.—Ferrous sulphate neutralises chromium in nickel sulphate baths, *p*H 5·4 to 5·8 (adjust the *p*H with nickel carbonate) stir and filter and readjust the *p*H to operating range.

77.—High metal ion concentration with low metal content produces large crystals and unsatisfactory throwing power: correct by addition of a salt with a common ion.

78.—Bright nickel baths filtered through activated carbon removes the brighteners; therefore brighteners must be added, if permissible.

Lead fluoride baths are determined daily for caustic soda contents; rough deposits occur with excess, black deposits occur when caustic content is low, green anode indicates a favourable operating condition.

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TABLE 16

PLATING BATHS—FAULTY DEPOSITS AND CORRECTION

Type of Plating Bath	TO PREVENT						TO IMPROVE		
	Pitting	Embrittlement and Excessive Hardness	Roughness and Excessive Porosity	Discoloration of Deposits (or of Anodes)	Poor Adhesion	Treeing	Throwing Power	Rate of Deposition	Brightness
Brass	60		27, 28, 49, 63	4, 37, 65 67, 68	36, 60	1	2, 8, 9, 27, 37, 50, 77	2, 4, 36, 50	63, 65
Cadmium ..	33, 60, 66		24, 40, 46, 49, 77	1, 24	31, 60, 66	1, 4	2, 3, 8, 9, 39, 50, 66, 77	2, 4, 34, 50	2, 31
Chromium ..		1, 4, 12, 19	13, 14, 19	12, 14, 19	14, 19, 51, 60	1, 4, 14	2, 3, 10, 13, 14, 43, 70	2, 4, 14, 19, 42-30	19, 43, 70
Copper .. (cyanide)	24, 60, 66	1, 4, 66	1, 3, 30, 37, 38, 40, 49, 77	1, 36 or 37, 60, 64	36, 60, 66	1, 4, 50	2, 3, 9, 24, 28, 39, 50, 55, 77	2, 4, 36, 50	41, 45
Copper .. (rochelle)	5, 7, 24, 28, 61	1, 4, 66	1, 5, 30, 36, 38, 40, 49, 56, 77	1, 36 or 37, 56, 61, 54	1, 60	1, 4, 50	2, 3, 7, 9, 24, 28, 39, 50, 55, 77	2, 4, 7, 50	7, 45, 55
Copper .. (acid)	5, 7	1, 4, 5, 7, 31, 50	1, 5, 34, 74, 77	1, 4, 5, 56	20, 22, 31	1, 4, 50	3, 9, 34, 39, 77	4, 31, 50	34

TABLE 16—*continued*

Gold	1, 60	1, 60	1, 13, 59, 60, 77	59, 72	1, 60	50	3, 9, 13, 39, 50, 77	4, 50, 59, 71	59, 60, 72
Nickel .. .. (hard)	48, 58, 71	1, 4, 12, 16, 25, 28, 34	5, 16, 25, 26, 28, 29, 38, 62, 71, 77	25, 26	9, 15, 20, 23, 25, 35, 51, 60, 71, 73	1, 4, 5, 50	1, 9, 26, 34, 39, 50, 52, 71, 77	2, 4, 5, 17, 26, 50, 71	26, 71
Nickel .. .. (all chloride)	48, 58, 71	1, 4, 12, 16, 25, 28, 34	1, 4, 5, 16, 25, 26, 28, 29, 38, 49, 62, 71, 77	1, 4, 25, 39, 62	1, 15, 20, 23, 25, 35, 51, 60	1, 4, 5, 50	1, 9, 26, 34, 39, 50, 52, 77	2, 4, 5, 17, 26, 50, 71	26, 7, 71
Nickel .. .. (sulphate) ..	16, 24, 25, 28, 48, 58, 71, 76	1, 4, 12, 16, 25, 28, 34, 47, 70 71	1, 5, 16, 25, 26, 28, 29, 34, 38, 49, 58, 62, 70, 76, 77	1, 4, 25, 39, 62, 71	1, 15, 20, 23, 35, 57, 60, 76	1, 4, 5, 50	1, 5, 9, 28, 34, 39, 47, 50, 52, 77	2, 4, 5, 17, 34, 39, 50, 71	7, 45, 70, 76
Nickel .. .. (Watts) and (bright types)	25, 26, 28, 48, 58, 71	1, 4, 12, 16, 25, 28, 34, 47, 71, 78	1, 5, 16, 24, 25, 26, 28, 29, 38, 49, 58, 62, 71, 77	1, 4, 62, 71	1, 15, 20, 23, 35, 51, 60, 71	1, 4, 5, 7, 34, 50	1, 25, 26, 34, 39, 47, 50, 52, 77	2, 4, 5, 17, 26, 50, 71	45, 71, 78
Silver	4, 38, 44	4, 12	1, 5, 16, 28, 38, 41, 44, 49, 57, 59, 77	40, 53, 57 59	5, 21, 36, 46, 60, 75	50	2, 3, 9, 37, 39, 41, 57, 77	2, 4, 17, 37, 39, 50	2, 3, 16, 17, 37, 45, 53, 57, 75
Tin .. .. (stannate)	3, 6, 10	3, 6, 10, 11, 24, 40, 60	6, 11, 28, 32, 54, 69, 77	3, 11, 54	24, 28, 54, 60	50, 54, 69	1, 3, 33, 39, 41, 50, 54, 77	2, 4, 5, 50, 54	11, 54
Zinc .. .. (cyanide)	24, 66	11, 12, 24, 60	11, 24, 38, 49, 77	64, 66	66	50, 54	2, 3, 8, 9, 18, 24, 28, 37, 38, 50, 54, 77	2, 4, 18, 50	24, 45

TABLE 17

PHYSICAL CONTROL OF PLATING BATHS

(S = suggested: R = required: No = Not Necessary. Throwing Power or Covering Power Implies Relative Uniformity of Deposits in Recesses, etc.)

Plating Baths and Average Efficiencies	Typical Formulae of Electrolytes, Per Gallon of Water	pH	Volts	Current Density Per sq. ft.	Temperature, °F	Filtration	Agitation	Throwing Power	Usual Tank Material and Anodes
Brass 60-70%	4·8 oz. copper cyanide 1·5 oz. zinc cyanide 9 oz. sodium cyanide 4·8 oz. sodium carbonate Arsenic brightener or alum if desired	11·5 13·6	2 to 3	3 to 5	90 to 100	S	S	B	Steel; brass
Cadmium 85%	4½ oz. cadmium oxide 17½ oz. sodium cyanide 2½ to 7 oz. sodium carbonate Brightener as required	13	(still) 1·0 to 4·0 (barrel) 7 to 14	(still) 15 to 45 (barrel) 5 to 25	70 to 95	No	No	B	Steel; Cd.
Chromium 12-16%	40 or 64 oz. chromic acid 0·4 or 0·64 oz. sulphuric acid—1 gallon water Anode-cathode distance 3 in.	Not controlled	4 to 12	100 to 1,000, average 130 to 400	100 to 140	No	No S for hard chromium	F	Tellurium; lead; 7 p.c. tin-lead
Copper (cyanide) 30-60%	3·6 oz. copper cyanide 2·4 oz. sodium cyanide 5·5 oz. sodium carbonate with brighteners such as arsenic if desired	12 to 13	1·5 to 2·0 (warm solution)	2·5 to 1·5	75 to 100	S	No	B	Steel; rolled annealed copper
Copper (Rochelle) 40-65%	3½ to 7 oz. copper cyanide 3½ to 8 oz. sodium cyanide 3½ to 9½ oz. Rochelle salts 2½ to 9½ oz. sodium carbonate	12·2 12·8	2 to 3	20 to 60	140 to 160	S	S (gentle)	B	Rubber lined; copper
Copper (acid) 95-99%	32 oz. copper sulphate 7½ oz. sulphuric acid Addition agents such as glue or dextrose or others if desired	Not controlled	¾ to 2	15 to 40	75 to 120	S	Harder copper deposits require air agitation	C	Lead (6 lb.) rolled annealed; copper
Gold 70-85%	0·3 to 0·6 troy oz. gold as potassium gold cyanide 0·36 to 0·6 oz. potassium cyanide 0·6 oz. sodium diphosphate	Not controlled	2 to 5	2 to 10	14 to 160	No	No	A	Ceramic or rubber; gold
Lead	20 oz. Basic Lead Carbonate ($2PbCO_3 . Pb(OH)_2$) 36 oz. Hydrofluoric Acid (60%) 16 oz. Boric Acid	1 to 2	3	15 to 20	60 to 70	S	No	C	Rubber lined; Antimony free lead

	36 oz. Hydrofluoric Acid (60%) 16 oz. Boric Acid								free lead
Nickel (hard) ..	6 oz. nickel as nickel sulphate 4·8 oz. ammonium chloride 4·8 oz. boric acid	5·5 5·9 critical	4 to 6	25 to 100	120 to 140	R	R (mechanical)	D	Rubber; nickel
Nickel (all chloride)	48 oz. nickel chloride 4·8 oz. boric acid	2·0	0·5	50 (20 to 100)	120 to 150	R	R (mechanical)	D	Rubber; nickel
Nickel (sulphate)	Still bath 9½ oz. nickel sulphate 3½ oz. ammonium chloride 3½ to 6 oz. boric acid (barrel 24 oz., 4·8 oz., and 4·8 oz. respectively) Hydrogen peroxide as required	4 to 5·8	1·5 to 2	5 to 15 or 25 to 40 agitated	Room temperature or 75° to 90° F	R	R (mechanical)	D	Acid brick, etc.; nickel
Nickel (Watts) ..	40 to 57 oz. nickel sulphate 7 to 11 oz. nickel chloride 4·8 to 7 oz. boric acid	1·5 to 3 or 4·5 to 5·0	1 to 6 6 to 12	15 to 50	120 to 160	R	R	D	Rubber; lead; nickel
Rhodium .. 35-40%	8·5 gms. ammonium Rhodinitrite (23% Rh.) fumed with 33 c.c. conc. H_2SO_4. Make up to 1 litre			5	90 to 120	No	No	A	Rubber; platinum glass
Silver 100%	6 oz. potassium cyanide 4 oz. silver cyanide 4 oz. potassium carbonate 0·15 fluid oz. CS_2 in silver solution		less than 1	3 to 4	70 to 80	S	S	A	Rubber or ceramics; fine silver glass
Tin (stannate sodium) .. 70-85%	(Still—barrel) 9½ to 24 oz. sodium stannate 1·8 to 2·4 oz. caustic soda 2·4 to 3·6 oz. sodium acetate 0·075 oz. hydrogen peroxide		(still) 4 to 6; (barrel) 6 or more	(still) 5 to 25; (barrel) 3 to 10	146 to 176 160 to 180	No	No	A	Steel; tin
Zinc (cyanide) .. 85-90%	9·6 oz. zinc cyanide 8 oz. caustic soda 3·6 oz. sodium cyanide	12·2 to 12·7	1·5 to 6; (barrel) 10 to 15	10 to 20	105 to 120	R	S	B	Steel, zinc
Zinc (acid) .. 97-99%	42 oz. zinc sulphate 2·4 to 4·8 oz. ammonium chloride 4·8 oz. aluminium sulphate 14½ oz. glue	3·5 to 4·6 (still) 5·0 to 5·3 (barrel)	1 to 6	50 to 100 agitated	Room temperature	No	S	D	Lead or rubber; zinc

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TABLE 18

SALT SPRAY RESISTANCES OF VARIOUS THICKNESSES OF ELECTRODEPOSITS

Electrodeposit of the Following Metals on Steel	Types of Exposure		
	Severe	General	Mild
(1) Brass thickness, in.	0·0006	0·0004 to 0·0005	0·0002
20 p.c. salt spray resistance, hr.	290	140	80
(2) Cadmium thickness, in.	0·0005	0·0003	0·00015
20 p.c. salt spray resistance, hr.	250	200	75
(3) Chromium thickness, in.	0·000025	—	—
20 p.c. salt spray resistance, hr.	16	—	—
(4) Chromium and nickel total thickness, in.	0·000325	0·000125	—
Thickness of nickel plate, in.	0·0003	0·0001	—
20 p.c. salt spray resistance, hr.	48	16	—
(5) Copper and nickel total thickness in.	0·00125	0·00075	0·0004
Nickel thickness, in.	0·0006	0·0004	0·0002
Chromium (min.) thickness (if wanted), in.	0·00001	0·00001	0·00001
20 p.c. salt spray resistance, hr.	72	48	16
(6) Lead thickness, in.	0·004	0·002	0·0002
20 p.c. salt spray resistance, hr.	250	150	30
(7) Nickel thickness, in.	0·001	—	—
20 p.c. salt spray resistance, hr.	100	—	—
(8) Tin thickness, in.	0·0003 to 0·0005	0·0002	0·0002
20 p.c. salt spray resistance, hr.	250	150	30
(9) Zinc, in.	0·001	0·0005	0·00015
20 p.c. salt spray resistance, hr.	220	140	80
Max. number of spots per sq. ft. no larger than $\frac{1}{8}$ in.	6	6	6
Electrodeposits on zinc die castings	—	—	—
(10) Copper and nickel thickness, in.	0·00125	0·00075	0·0005
Copper (min.), in.	0·0004	0·0003	0·0002
Final nickel (min.), in.	0·0005	0·0003	0·0003
Chromium if required, in.	0·00001	0·0001	0·00001
20 p.c. salt spray resistance, hr.	48	32	16
(11) Chromium thickness on zinc, in.	0·000025	—	—
20 p.c. salt spray resistance, hr.	48	—	—
Electrodeposits on brass	—	—	—
(12) Nickel on brass, in.	0·0006	0·0004	0·0002
20 p.c. salt spray resistance, hr.	48	20	7

Salt spray tests are not worthy of too much emphasis as to evaluating corrosion protection under normal atmospheric conditions. They serve as an arbitrary comparative test.

TABLE 19

ELECTROCHEMICAL EQUIVALENTS

Calculated on Basis of 100% *Cathode Efficiency*

Metal	Symbol	Valence	Atomic Weight	Specific Gravity	Thickness in Inches of 1 oz./sq. ft.	Grams Deposited per Amp. Hr.	Amp. Hr. Per sq. Ft. to Deposit 0·001 in.
Antimony	Sb	3	121·76	6·68	·00180	1·514	10·4
Cadmium	Cd	2	112·41	8·65	·00139	2·0968	9·73
Chromium	Cr	6	52·01	7·1	·00169	0·3233	51·8
Cobalt (ous)	Co	2	58·94	8·9	·00135	1·100	19·0
Copper (ous)	Cu	1	63·57	8·93	·00134	2·371	8·89
Copper (ic)	Cu	2	63·57	8·93	·00134	1·186	17·8
Gold (ous)	Au	1	197·2	19·3	·00068 •	7·356	6·2
Gold (ic)	Au	3	197·2	19·3	·00068 •	2·450	18·6
Hydrogen	H	1	1·0078	0·0899 g./l	—	0·0376	—
Indium	In	3	114·76	7·31	·00182 •	1·427	12·0
Iron (ous)	Fe	2	55·84	7·87	·00153	1·042	17·9
Lead	Pb	2	207·22	11·35	·00106	3·865	6·9
Nickel	Ni	2	58·69	8·90	·00135	1·095	19·0
Oxygen	O	2	16·00	1·429 g./l (0°C.)	—	0·2985	—
Palladium	Pd	2	106·7	11·40	·00116 •	1·990	13·5
Platinum	Pt	4	195·23	21·45	·00062 •	1·821	27·8
Rhodium	Rh	3	102·91	12·5	·00106 •	1·280	22·9
Silver	Ag	1	107·88	10·5	·00126 •	4·025	6·2
Tin (ous)	Sn	2	118·70	7·3 (tetragonal)	·00164	2·214	7·8
Tin (ic)	Sn	4	118·70	7·3	·00164	1·107	15·6
Zinc	Zn	2	65·38	7·14	·00168	1·182	14·3

• *These figures are for* 1 *troy ounce per square foot.*

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TABLE 20. ACCELERATED THICKNESS AND THICKNESS TEST

Deposits	Magnetic Test of Deposit Thickness On	Dropping Tests		Stripping Test
		Reagents	Thickness of Metal Removed	Reagents for Deposits over 0·0002 in.
Brass	Steel	1 p.c. Sulphuric 1 p.c. Potassium ferricyanide 1 litre water	1 sec. 0·00002 in. —blue spot	
Cadmium and Zinc	Steel or Nickel	200 g. per litre chromic acid 50 g. per litre sulphuric acid 1 litre water	1 sec. at 75° F for Cd = 0·0000138 in.; Zn = 0·0000102 in.	On steel: 3·3 oz. antimony chloride and 1 gal. of water, 1 gal. (1·18 sp. gr.) hydrochloric acid-stock solution. 1 volume stock solution to 24 volumes concentrated hydrochloric acid (on castings use stock solution only)
Chromium	Steel or Nickel	Drop of 1·18 sp. gr. hydrochloric acid in ¼-in. ring of wax, touch Cr with nickel wire	1 sec. start to stop of gas = 0·00000095 in.	On steel: Anodic in caustic soda On brass and copper: Cathodic 2 min. in acid copper bath at 0·2v. On nickel or zinc: Anodic in sodium carbonate solution
Copper	Steel or Nickel	450 g. per litre ferric chloride 20 g. per litre antimony trioxide 200 mg. per litre concentrated hydrochloric acid 250 mg. per litre acetic acid	1 sec. at 75° F. = 0·000005 in.	On steel: 5 lb. chromic acid and 8 oz. sulphuric acid On zinc or steel: Dissolve 5·2 oz. sulphur in hot 41 oz. sodium sulphide to gallon of water Brush off sludge, before weighing
Gold	Nickel or Steel			On brass · Quantitative analysis On steel: 12 oz. sodium cyanide and 2 oz. caustic soda saturated with potassium chromate at 140° to 160° F.
Lead	Steel			On steel: Solution 20 oz. to 30 oz. caustic soda saturated with potassium chromate at 175° F.
Nickel	Steel or Copper or Brass or Aluminium			On steel: 85 p.c. to 95 p.c. (1·50 sp. gr.) nitric acid and rinse On Zinc: 70 p.c. sulphuric anodic at 20 A. S. F. On Copper or Brass: 1 lb. NaSCN and 1 lb. $NaHSO_3$ per gal. water at 20 A/ft² 3v. anodic
Silver	Nickel or Steel			On Brass: 1 volume concentrated nitric acid, 10 volume concentrated sulphuric acid, at 175° F.
Tin	Steel	Solution of trichloracetic acid, 100 g. per litre	At 75° F. 0·00001 in per sec.	On Steel: 3·9 oz. antimony trichloride and 1 gal. hydrochloric acid and 1/3 gal. water

For heavy deposits of nickel on copper or brass: Porosity test—moisten filter paper 50 p.c. $NaNO_3$ and place lead is cathode, and treat for 30 min., then immerse paper in K ferrocyanide. Solution 50 g per litre and 30

POROSITY TESTS OF PLATED SURFACES

ING PROCEDURES

K	Rate and Thickness of Metal Removed	Other Methods	Porosity Tests (Six Spots or Less Per Sq. In. for a Good Plate)
		B.N.F. Jet. (B.S.S. 1224. 1945) Solution F.C.	20 p.c. salt spray
Cd = 0·201 Zn = 0·243		Preece test but it gives unreliable results B.N.F. Jet. No. 3 Soln. Cd. B.N.F. Jet. No. 4 Soln. Zn.	20 p.c. salt spray for Cd
0·243	0·001 in. in few minutes	Degrease, moisten metal with magnesium paste and rinse. Dip in concentrated hydrochloric acid containing antimony trioxide—surface darkens, gassing stops, calibrate with specimen B.N.F. Jet	60 g. per litre sodium chloride and 0·5 g. per litre potassium ferricyanide on filter paper apply paper to metal for 10 min. Dry paper and moisten in salt solution = blue spots
0·195	(on steel) 0·001 in. at room temperature in 20 min. and 3 min. at 212° F.	Drop of 1 : 1 nitric acid, blot off in a second—repeat until brown stain appears, each second = 0·0001 in. B.N.F. Jet. Soln. F.C.	Salt spray and moisten rag paper on one side with 50 g. per litre NaCl, 50 g. per litre gelatine. Dry, apply treated side to metal and moisten by brushing with 50 g. per litre NaCl for 10 min., remove and immerse paper in 10 g. per litre (1) potassium ferricyanide for steel, or (2) potassium ferricyanide solution for nickel base
0·0896	(on steel) 0·001 in. at room temperature in a few minutes	Half-saturated alcoholic solution of dimethyl-glyoxime anodic at 6v., weight before and after stripping or J. Electrodepos. Tech. Soc. 1948. 23 113/120	On nickel: 3 oz. agar, 6 oz. NaCl, 100 c.c. water and little ammonia, 10 c.c. solution alcoholic dimethyglyoxime, on filter paper and apply to metal
0·153	0·0005 in. in 5 min.		Special ferroxyl test : Steel: 10 g. per litre K ferricyanide on filter paper 10 min. blue spot
0·195	0·001 in. at room temperature in 20 min.	B.N.F. Jet Soln. F.C.	20 p.c. salt spray Modified ferroxyl test same as for copper (1) for steel basis metal (2) for brass
0·165	Dissolves in a few minutes	B.N.F. Jet Soln. No. 5	Ferroxyl test—potassium ferricyanide on steel and potassium ferrocyanide on brass or copper
0·237	Thin coats in about 2 min.		Hot water, 6 hr., no spots, good. Ammonia fumes under bell jar 4 hr., no spots (tin on brass is good. Also, for Ni on steel with hot water test)

on metal over which plate a sheet of lead or nickel. Apply 2 milliamps per sq. in. Metal is the anode, ml. per litre acetic acid = brown spots.

TABLE 21

PHYSICAL CHARACTERISTICS OF ELECTRODEPOSITED COATS
(Relative values: A as highest comparative value with declining values depicted down to D)

Deposits	Porosity	Hardness, Bhn.	Ductility	Tensile Strength, Psi; Also % Elongation	Buff-ability	% Reflectivity (Buffed, Nearest Colour)	Electric Conductivity % I.C.S.	Rate of Deposition (Min. to Deposit 0·0003 in.)
Aluminium Oxide (Anodic)	A	700 to 800	A	5 % less than basis metal	B	60 to 78 %	0 (dielectric)	20 min. (average)
Brass	C	42 to 79	B	30,000 at 50 % to 37,000 at 40 %	A	55 to 60 %, about equal to pale-green	26 to 43	Varies widely
Cadmium	B	12 to 22	B	13,000 at 44 %	C	85 %, ivory	24	10 min. at 20 amps. per sq. ft. (tank); 30 min. (barrel)
Chromium	C	400 to 950	E	—	C	60 to 66 %, sky-blue	13	18 min. at 400 amps. per sq. ft.; 2½ min. at 200 amps. per sq. ft. or 5 min. at 100 amps. per sq. ft.
Copper (cyanide bath)	C	130 to 160	B	12,000 at 35 % to 50,000 at 5 %	B	55 %, pale-green	100	17·4 min. at 15 amps. per sq. ft. for 0·0003 in.
Copper (Rochelle bath)	C	130 to 160	B	12,000 at 35 % to 50,000 at 5 %	B	55 %, pale-green	100	140° F., 6·6 min. at 60 amps. per sq. ft.; 11 min. at 20 amps. per sq. ft. (anode area twice cathode)
Copper (acid sulphate)	D	40 to 62	B	10,000 at 40 % to 40,000 at 3 %	B	55 %, pale-green	100	8 to 21 min.

				40,000 at 3 %				
Copper (bright bath, proprietary)	B	130 to 180	B	15,000 at 40 % to 55,000 at 5 %	A	55 %, pale-green	100	6 min.
Gold	A	25 to 30	A	13,000 at 45 to 70 %	A	78 %, canary yellow	70	12 min. at 20 amps. per sq. ft. usual deposits 0·00075 in.
Nickel (hard bath)	A	450	E	170,000 at 3 %	C	55 %, pale-green	16	8 min. at 100 amps. per sq. ft.; 15 min. at 50 amps. per sq. ft.
Nickel (sulphate bath)	D	125 to 175	D	50,000 at 30 %	C	55 %, pale-green	16	100 min. at 50 amps. per sq. ft.
Nickel (all chloride)	A-B	220	C-D	100,000 at 30 %	B	55 %, pale-green	16	8 min. at 50 amps. per sq. ft.
Nickel (hot Watts bath)	C	125 to 175	C	50,000 at 30 %	C	55 %, pale green	16	10 min. at 50 amps. per sq. ft.
Nickel (bright baths)	A	300	C	30,000 at 35 %	A	55 %, pale-green	16	10 min. at 50 amps. per sq. ft.
Platinum	A	600 to 645	A	45,000 at 90 %	A	78 %, ivory	15	30 to 60 sec. usually deposits 0·000001 in.
Rhodium	A	590 to 640	A	50 %	A	78 %, ivory	45	5 sec. for 0·000001 in.
Silver (cyanide)	A	60 to 79	A	30,000 at 50 %	A	85 to 95 %, white	103	9 min. at 30 amps. per sq. ft.
Tin (stannate)	D	8 to 9	D	——	B	82 %, ivory	14	30 min. at 25 amps. per sq. ft.; 0·00075 in. usual thickness deposited
Zinc (cyanide bath)	C	40 to 60	A	17,000 at 17 %	B	74 %, canary yellow	28	11·4 min. at 25 amps. per sq. ft.; 5 min. at 75 amps. per sq. ft.

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TABLE 22

ATMOSPHERIC EXPOSURE TESTS ON ELECTROPLATED STEEL

(Results of 18 months exposure tests conducted by American Society for Testing Materials, American Electroplating Society and National Bureau of Standards.)

Exposure Site: (1) Non-industrial (2) Industrial (3) Marine	Nickel, Thickness, In.			Cadmium, Thickness, In.			Nickel-Chrome-Copper, Thickness, In.	
	0·000025	0·0005	0·001	0·0002	0·0005	0·001	Total Nickel and Chrome = 0·001 (Cr = 0·03002)	Copper = 0·0003 Nickel = 0·0005 Chromium = 0·00002
Washington	35	82	86	97	100	98	94	95
State College, Pa.	31	70	87	100	100	100	98	97
Pittsburgh	8	20	36	44	82	86	23	20
New York	17	30	67	37	64	77	72	68
Key West	10	25	67	85	85	85	58	40
Sandy Hook	10	27	62	86	93	91	51	46

SCORE	100 (perfect)	80 (excellent)	60 (very good)	40 (good)	20 (fair to poor)	0 (poor)
P.c. of surface rusted	0	0 to 5	5 to 10	10 to 20	20 to 50	50 to 100

The protective nature of zinc and cadmium contrast with the lack of protection and the definitely accelerating effect chromium and nickel exert on the corrosion of base iron; thus, rust will "bleed" from the pores in chromium and nickel plate.

TABLE 23

METAL CONTENT OF COMMON PLATING SALTS

(Commercial products usually vary slightly from stated percentages.)

Technical Name of Salt	*Chemical Formula*	*Per Cent. Metal*
Antimony trichloride	$SbCl_3$	53·4
Cadmium cyanide	$Cd(CN)_2$	68·3
Cadmium oxide	CdO	87·5
Chromic acid	CrO_3	52·0
Cobalt sulphate (anhydrous)	$CoSO_4$	38·0
Cobalt sulphate, crystal	$CoSO_4{\cdot}7H_2O$	21·0
Copper carbonate (basic)	$CuCO_3{\cdot}Cu(OH)_2$	57·5
Copper chloride (ic)	$CuCl_2$	47·3
Copper cyanide (ous)	$CuCN$	71·0
Copper sulphate (ic), crystal	$CuSO_4{\cdot}5H_2O$	25·5
Ferrous chloride, crystal	$FeCl_2{\cdot}4H_2O$	28·1
Ferrous ammonium sulphate	$FeSO_4{\cdot}(NH_4)_2SO_4{\cdot}6H_2O$	14·2
Gold chloride (ic)	$AuCl_3$	64·9
Gold chloride (ic), crystals	$AuCl_3{\cdot}2H_2O$	58·1
Gold chloride (ous)	$AuCl$	84·7
Gold cyanide (ous)	$AuCN$	88·3
Gold potassium cyanide	$KAu(CN)_2$	68·3
Gold potassium cyanide, crystal	$KAu(CN)_2{\cdot}2H_2O$	60·8
Gold sodium cyanide	$NaAu(CN)_2$	72·5
Lead carbonate (basic)	$Pb(OH)_2{\cdot}2PbCO_3$	80·1
Mercuric chloride	$HgCl_2$	73·8
Mercuric cyanide	$Hg(CN)_2$	79·4
Mercuric nitrate	$Hg(NO_3)_2$	61·8
Mercuric nitrate, crystal	$Hg(NO_3)_2.H_2O$	58·6
Nickel ammonium sulphate (double nickel salts)	$NiSO_4.(NH_4)_2SO_4{\cdot}6H_2O$	14·9
Nickel carbonate (basic)	$2NiCO_3{\cdot}3Ni(OH)_2{\cdot}4H_2O$	50·0
Nickel chloride, crystal	$NiCl_2{\cdot}6H_2O$	24·7
Nickel sulphate (single nickel salt)	$NiSO_4{\cdot}6H_2O$	22·3
Platinum chloride, crystal	$H_2PtCl_6{\cdot}6H_2O$	37·7
Rhodium phosphate, crystal	$RhPO_4{\cdot}3H_2O$	29·9
Rhodium sulphate, crystal	$Rh_2(SO_4)_3{\cdot}12H_2O$	29·0
Silver chloride	$AgCl$	75·3
Silver cyanide	$AgCN$	80·5
Silver potassium cyanide	$KAg(CN)_2$	54·2
Silver sodium cyanide	$NaAg(CN)_2$	59·0
Silver nitrate	$AgNO_3$	63·5
Sodium stannate, crystal	$Na_2SnO_3{\cdot}3H_2O$	44·5
Tin chloride (ous), crystal	$SnCl_2{\cdot}2H_2O$	52·6
Tin sulphate (ous)	$SnSO_4$	55·3
Tungstic acid	H_2WO_4	73·6
Tungstic oxide	WO_3	79·3
Zinc cyanide	$Zn(CN)_2$	55·7
Zinc oxide	ZnO	80·3
Zinc sulphate, crystal	$ZnSO_4{\cdot}7H_2O$	22·7

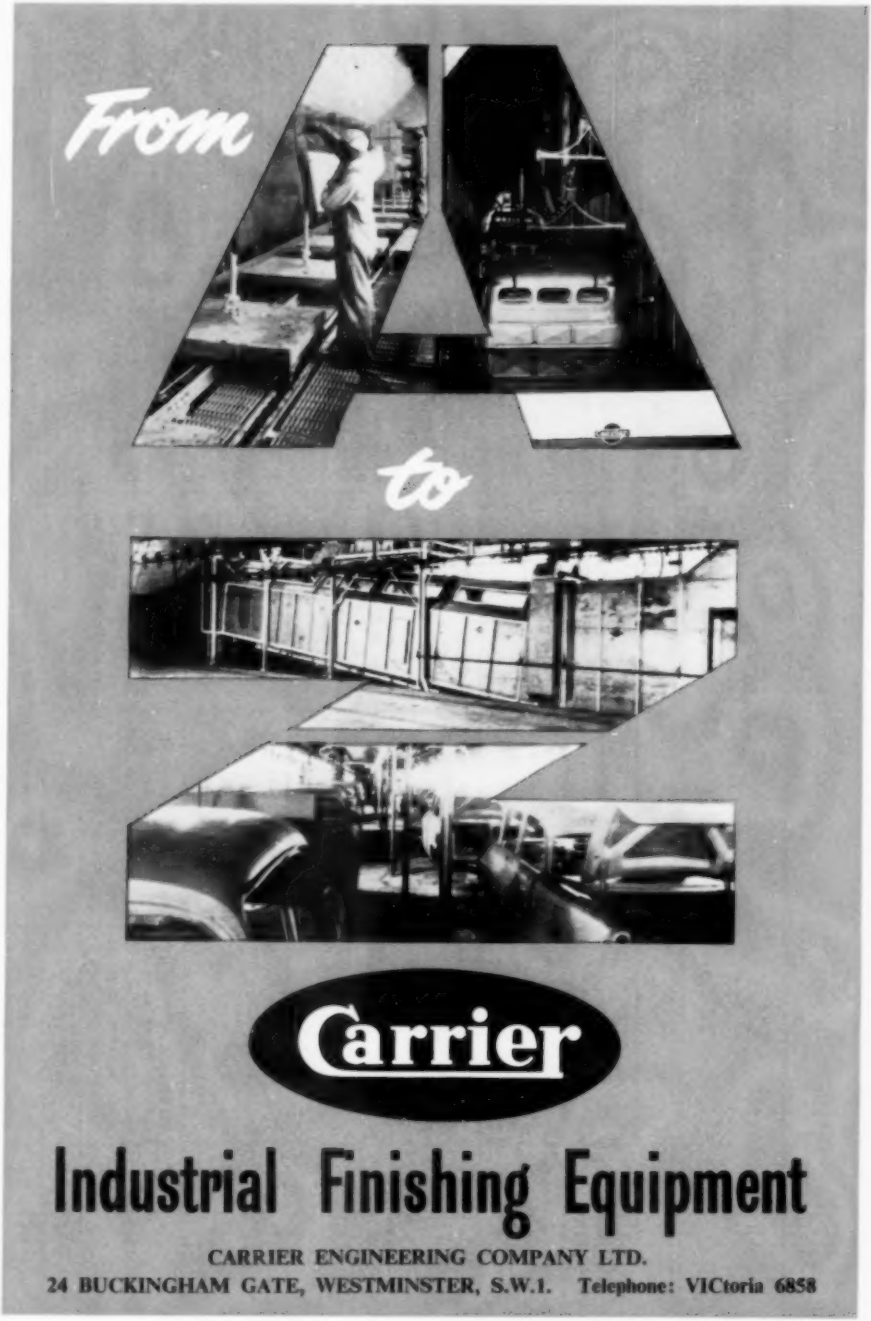
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TABLE 24

TYPICAL SOLUTIONS FOR STRIPPING ELECTRODEPOSITED COATS

Plate or Coat to be Stripped	Basis Metal or Alloy from which Coat or Plate is to be Stripped				
	Aluminium	Brass or Copper	Nickel or Nickel-Silver	Steel	Zinc
Aluminium oxide anodic and chemical oxide coats	Hot caustic solution etch badly; several proprietary solutions remove oxide with controlled etch	X	X	X	X
Brass	50% nitric acid at room temperature	See pickling and brightener tables	Same as on Steel	Reverse current in hot caustic soda solutions, 6 v. at room temperature	50% sulphuric acid at room temperature or reverse current in a sodium cyanide solution
Chromium	X	Same as on steel, or 1·2 pts. HCl and 1 gal. H_2O at 125° F., or concentrated HCl at room temperature	Same as on steel	Reverse current in hot caustic soda solutions 6 v. at room temperature, or reverse current in a sodium sulphide solution	
Copper	50% nitric acid at room temperature	X	Same as on steel	5 lb. chromic acid, 1 lb. sulphuric acid.	Chromic acid and ¼% sulphuric acid removes 0·001 in. in 20 min. at 212° F.; reactive the zinc in dilute hydrochloric acid
Gold	6 volumes sulphuric, 1 volume water at 6 v.; copper cathode; dip in 10% sodium cyanide to brighten	Same as on aluminium, or 6 volumes sulphuric and 1/10 volume lactic acids	Ammonium per sulphate at room temperature; or 5 oz. sodium cyanide, ½ to 3 oz. caustic soda, 1 gal. water. Anodic, 1 v. at 100° F., agitate	5 oz. concentrated hydrochloric acid, and 1½ fluid oz. glycerine, 1 gal. water, cathodic at 6 v.	Same as on steel
Lead or solder	50% nitric-acid for regular aluminium solders	Same as on steel	Same as on steel	20 oz. caustic soda 1 gal. water; anodic at 180° F. to 190° F.	X

	regular aluminium solders			water; anodic at 180° F. to 190° F.	

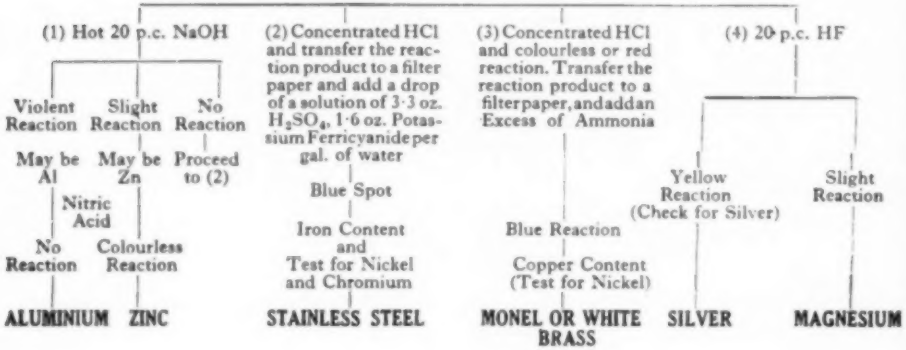
Plate or Coat to be Stripped	Basis Metal or Alloy from which Coat or Plate is to be Stripped				
	Aluminium	Brass or Copper	Nickel or Nickel-Silver	Steel	Zinc
Nickel	50 to 75% nitric acid	Same as on steel	X	1 volume concentrated nitric acid at 80° to 90° F. removes 0·001 in. in 20 min., or reverse current in (56° Be) sulphuric acid	Reverse current, 2% sulphuric acid, 10 to 30 amp. per sq. ft.; glycerine may be added
Platinum	X	X	Same as on steel	In contact with iron in hydrochloric acid; also in aqua regia	X
Rhodium	X	Same as on steel	Same as on steel	Molten sodium cyanide; or reverse current in a hydrochloric acid solution	X
Silver	50% nitric acid	Same as on aluminium	Same as on aluminium	Anodic in 15 oz. NaCN, 2½ oz. NaoH, and 1 gal. water; 6 v. at room temperature, steel cathode	Same as on steel
Tin	50% nitric acid	2½ oz. antimony trioxide, 1 gal. water; or same as steel	X	Reverse current, 40 to 60 amp. per sq. ft. in an alkaline solution; or same as silver from steel	X
Zinc or cadmium	50% nitric acid	Reverse current in a caustic soda solution	X	Reverse current in a caustic soda solution for cadmium 1 gal. hydrochloric, 2½ oz. antimony chloride, 1 pt. water, room temperature, remove smut in solution of 1½ lb. ammonium nitrate, 1 gal. water, room temperature	See pickling and brighteners tables

TABLE 25

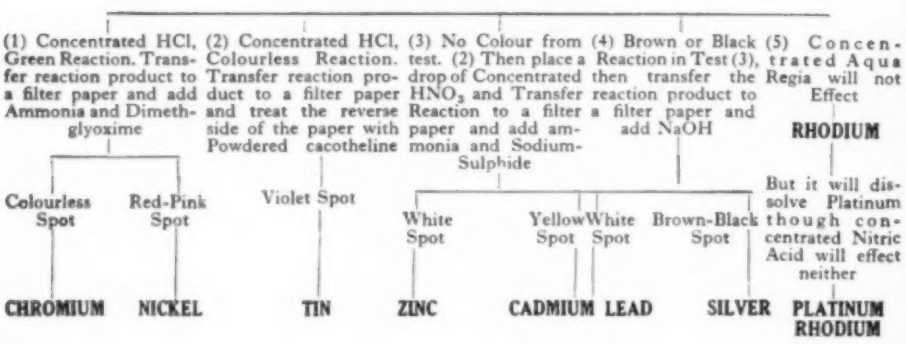
SPOT TEST IDENTIFICATION OF METAL SURFACES

Place a drop of the specified solution on the metal for 30 secs. Sequence "A" is for testing white metal when it is not certain whether it is surface treated or not. Sequence "B" is for testing white-plated surfaces and sequence "C" is for yellow and coloured metal surfaces.

"A"—WHITE METALS


(1) Hot 20 p.c. NaOH
Violent Reaction
Slight Reaction
No Reaction
May be Al
May be Zn
Proceed to (2)
Nitric Acid
No Reaction
Colourless Reaction
ALUMINIUM
ZINC
(2) Concentrated HCl and transfer the reaction product to a filter paper and add a drop of a solution of 3·3 oz. H_2SO_4, 1·6 oz. Potassium Ferricyanide per gal. of water
Blue Spot
Iron Content and Test for Nickel and Chromium
STAINLESS STEEL
(3) Concentrated HCl and colourless or red reaction. Transfer the reaction product to a filter paper, and add an Excess of Ammonia
Blue Reaction
Copper Content (Test for Nickel)
MONEL OR WHITE BRASS
(4) 20 p.c. HF
Yellow Reaction (Check for Silver)
Slight Reaction
SILVER
MAGNESIUM

"B"—WHITE PLATED SURFACES


(1) Concentrated HCl, Green Reaction. Transfer reaction product to a filter paper and add Ammonia and Dimethglyoxime
Colourless Spot
Red-Pink Spot
CHROMIUM
NICKEL
(2) Concentrated HCl, Colourless Reaction. Transfer reaction product to a filter paper and treat the reverse side of the paper with Powdered cacotheline
Violet Spot
TIN
(3) No Colour from test. (2) Then place a drop of Concentrated HNO_3 and Transfer Reaction to a filter paper and add ammonia and Sodium-Sulphide
White Spot
ZINC
Yellow Spot
White Spot
CADMIUM
LEAD
(4) Brown or Black Reaction in Test (3), then transfer the reaction product to a filter paper and add NaOH
Brown-Black Spot
SILVER
(5) Concentrated Aqua Regia will not Effect
RHODIUM
But it will dissolve Platinum though concentrated Nitric Acid will effect neither
PLATINUM
RHODIUM

"C"—YELLOW AND COLOURED METAL SURFACES

Apply an Open Flame to the "Coloured" Metal Surface

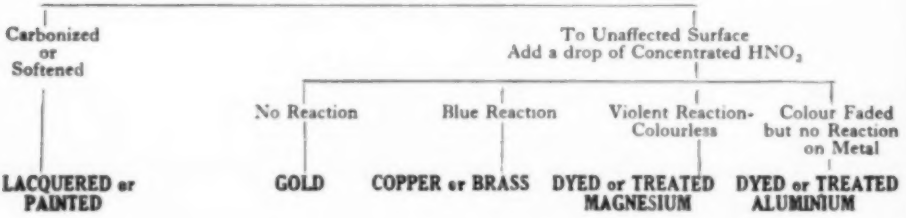


TABLE 26

Faults and remedies in bright nickel plating.

Signs	*Possible cause*	*Suggested remedy*
Black streaky deposit.	Contamination of solution with copper zinc or iron.	Load the cathode rod with clean scrap and work at low current density for several hours (5 amps. per sq. ft. at about 1 volt).
Dull deposit.	Lack of brightener.	Analysis of solution required.
	Low cobalt content.	Analysis of solution required.
	Temperature.	Check temperature.
	*p*H at fault.	Check *p*H with comparator.
	Cleaning stains.	Check cleaning and swills.
Dark in crevices.	Low chloride content.	Analysis of solution required.
	Too much brightener.	Analysis of solution required.
Stripping.	Cleaning.	Check all cleaning solutions and swills, see that the polishers are not leaving too much compo in crevices.
	Solution out of balance.	Check by analysis.
Pitting.	Grit or minute particles of dust.	Pressure filtration required. Continuous pressure filtration is required in a bright nickel bath and it is also advisable to employ activated charcoal as a filtering media at intervals, say once every three to four weeks.
Laminated deposits.	Intermittent contact.	Reduce air flow, clean rods, connections, etc.
	Too violent agitation.	

TABLE 26A

LIST OF PROPRIETARY BRIGHTENERS PATENTED IN BRITAIN AND U.S.A.

From this formidable list, remarks on the variation of the different addition products in relation to the mechanism whereby brightness is achieved can be well understood.

Patentee	*U.S. Patent No.*	*Brighteners*
Lutz and Westbrock	1,818,229	Benzyl naphthalene sodium sulphate
Pinner	1,837,835	Complex lead citrate
Pine	2,029,386	Sulphuric acid reaction products of oleo-resins and natural resins
	2,029,387	
Hull	2,085,754	Reaction products of alkali metal cyanides and certain aldehydes and ketones
Waite	2,112,818	Zinc or cadmium plus naphthalene-sulphonic acids

TABLE 26A—*continued*

Patentee	*U.S. Patent No.*	*Brighteners*
Harshaw and Long	2,125,229	Selenium plus sulphonates
Brown	2,191,813	Cd or Zn plus sulphonamides or sulphonimides
Lind, Harshaw and Long	2,198,267	Aminopolyaryl methane plus naphthalene sulphonate
	2,198,268	Aminopolyaryl methane plus single ring aryl sulphonamides and sulphimides
	2,290,342	Azo compound plus naphthalene sulphonates, single ring aryl sulphomides, or single ring aryl sulphimides
	2,238,861	Aromatic amino compounds plus an organic compound "Characterised by a ductilising tendency"
	2,326,999	Safranine compounds plus ortho benzoic sulphamide (saccharin) and its salts
ter Horst	2,361,720	Mercaptopyrimidines
Gaver	2,406,072	Starchates
Stocker and Freed	2,409,119	Sulphonated arylaldehydes
	2,409,120	Thiourea
Monsanto Chemical Co.	2,401,428	The sulphonation produce of hydrogenerated biphenol high-boiler converted to nickel salts
Udylite Corporation	2,402,801	Thallium sulphate and ortho benzoyl sulphonamide and paratoluene sulphonamide
Seymour Manufacturing Co.	2,409,119	Ortho sulphur benzaldehyde
Seymour Manufacturing Co.	2,409,120	Thiourea
Dupont de Nemours	2,417,203	A soluble sulphurised gelatine
	British Patent No.	
Schlötter	459,887	Aromatic sulphonic acids and alkali or alkaline earth halides
Mond Nickel Co. Ltd.	474,582	Egg albumen or blood albumen
Priston and Gardam	506,332	A monosulphonate with colloids such as gelatine, dextrin or lysablic acid
Parker-Wolverine	513,634	A soluble benzenedisulphonate with a soluble zinc salt
Udylite Corporation	525,848	Aldehydes or ketones
Udylite Corporation	525,847	Sulphonamides or sulphonimides with or without ketones or aldehydes
Houdaille-Hershey	526,966	Sodium formate
Houdaille-Hershey	526,967	Sodium formate and wetting agents
Houdaille-Hershey	526,968	Sodium formate and an inert anode
Harshaw Chemical	528,498	Triphenyl methane dyestuffs and aromatic sulphonate, a sulphonamide or sulphimide and the sulphate of a normal primary aliphatic alcohol with more than six carbon atoms.
Udylite	529,825	An aromatic sulphonic acid group with a soluble indigoid dye with or without aldehyde or ketones
Harshaw Chemical	533,901	Triphenyl methane dyestuffs
United States Rubber Co.	554,335	The reaction product of sulphuric acid and 2-mercapto 6 methyl-4, 6 diethyl dihydropyrimidine
Udylite Corporation		A thallium salt plus an aryl sulphonamide, an aryl sulphonate or an aryl sulphinate
E. I. Dupont de Nemours	579,109	The hydrogenation products of reducing sugar

NOMOGRAPH ON THICKNESSES OF ELECTRODEPOSITS

THE nomograph below is designed to answer the questions most frequently met by the plater who wishes to deposit a given thickness of metal. Given the metal to be plated and the current density, it indicates the time required to deposit a given thickness or conversely the thickness achieved in a known time.

For example, suppose it is desired to find the time necessary to produce a nickel plate 0·5 mils. (0·0005 in.) thick at a current density of 20 amperes per square foot. To determine this from the chart, draw a line with a ruler from the nickel point through the 0·5 mil. point intersecting the reference line R. This intersection is connected to the 20 amperes per square foot by another straight line, which when extended to the time scale gives the required time, in this case 29 mins.

To calculate the amount of metal deposited in a given time, this procedure is reversed.

It must be noted that this nomograph is based on 100 per cent. current efficiencies, hence the actual plating times will be greater. In the above example if the current efficiency were 95 per cent. the total plating time would be 29 divided by 0·95 or 30·5 mins.

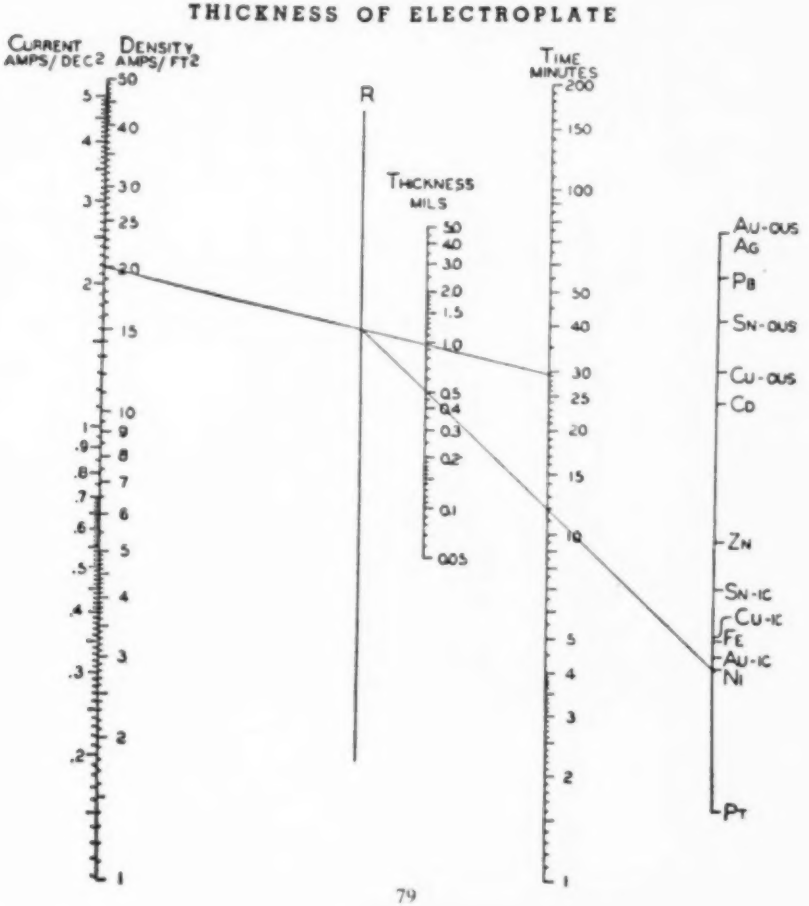


TABLE 27

METAL COLOURING TREATMENTS

METAL Treated	Materials	Temperature	Remarks on process	Colour obtained
Steel	(1)	800° C.	Heat in contact with air and then superheated steam. High durability	Black
	(2)	600° C.	Heat in partially dissociated low-pressure steam obtained by passage through iron tube for ½ hr.	Black
	(3) Sodium nitrate or mixture with potassium nitrate	300° C.	Heat in fused salt Lower temperature (more difficult to control)	Blue-Black Brown
	(4) 80 oz. caustic soda 50 oz. potassium nitrate 1 gallon water or	140° C. for 10 min.	Cast-iron or steel tank. Water additions with **CARE**. Baths deteriorate and iron salts accumulate. Sometimes two baths, first at lower concn.	Black
	(5) 7½ lb. caustic soda 2½ lb. sodium nitrate 1 gallon water ("Jetal")	250–300° F. 30 min.	Regenerate with ½ lb. sodium cyanide per 100 sq. ft. of metal treated and replace drag-out losses. Increase in 5–10 p.c. hydrofluoric acid before treatment for cast-iron and cold-rolled sheet	Black
	NOTE.—*3, 4 and 5 used for paint adhesion but probably not so good as phosphating. Not suitable for folds, recesses or soldered joints.*			
	NOTE.—*Phosphating processes convert steel surfaces into a thin film of iron phosphate and aid paint application whilst preventing corrosion spread when the paint surface is damaged. It is recommended that suppliers of the various proprietary solutions should be consulted.*			
	(6) 1½ oz. selenious acid 3 oz. copper sulphate (cryst.) 1½ fl. oz. nitric acid (1·2) 1 gallon water	Room	Rubbing and brushing in contact is necessary	Dark Grey or black
	(7) 1½ oz. lead acetate 1½ oz. sod. thiosulphate 1 gallon water	120° F.	As above. Colour range depends on immersion time	Red to purple or blue-black
	(8) 20 oz. arsenious oxide 10 oz. copper sulphate 2 oz. ammon. chloride 1 gallon hydrochloric acid	Room temp. or warm to speed reaction	Dissolve the oxide in the acid and add the other constituents *N.B.*—Will give similar finish on tin, zinc or cadmium if solution diluted ten to fifteen times	Steel bronze

	2 oz. ammon. chloride 1 gallon hydrochloric acid	speed reaction	*N.B.*—Will give similar finish on tin, zinc or cadmium if solution diluted ten to fifteen times	
Copper and its alloys *N.B.*—Or copper-plated steel	(9) 2 oz. potassium sulphide 1 gallon water	160° F.	Brush in contact. Rinse, dry in sawdust and "relieve" with pumice (sulphide coating)	Brown shades
	(10) 2–4 oz. sod. thioantimoniate 1 gallon water	Room	Dip into solution and very weak sulphuric acid alternately for accelerated colouring. More rapid darkening by using dilute mercuric nitrate instead of acid. (Sulphide coating)	Brown shades (glossy)
	(11) 20 oz. sod. thiosulphate 16 oz. lead acetate 1 gallon water	100–140° F.	Colours depend on temperature and time. Increasing concn. of thiosulphate or adding tartaric or acetic acid increases the rate of colour development. Rinse and dry	Yellow to blue
	(12) Fused sodium nitrate, nitrate or mixture	350–450° C. 5 min.	Parts dry and grease free. Dip in molten paraffin wax, buff and lacquer. (Oxide coating)	Red
	(13) 1½ oz. caustic soda ½ oz. ammon. persulphate 1 gallon water	Boiling point 5 min.	Rub after treatment. Persulphate additions necessary	Black (matt)
	(14) 3 lb. basic copper acetate 1 lb. copper carbonate 3 lb. ammon. chloride 1 quart hydrochloric acid ¼ lb. arsenious acid Water to make paste	Room 2–3 days	Immerse in paste, brush in well. Repeat till desired colour	Green Latina (resembles copper roof exposure colour)
Brass	Treatments outlined for copper but the zinc compounds are uncoloured so that there is a chance of irregularity			
	(15) 2 lb. copper carbonate 1 gallon ammonia (Sp. G. ·88) 1 gallon water	Room		Bluish black
Cadmium	(16) ¼ oz. lead acetate 12 oz. sod. thiosulphate 1 gallon water	100–140° F.	Deposits tend to be powdery with poor adhesion	Black
	(17) 2½ oz. copper sulphate (cryst.) 3 oz. pot. chlorate 3 oz. sod. chloride 1 gallon water	180–200° F. Few seconds	Rubber lined or ceramic vat. If precipitate tends to form add few drops of sulphuric acid. Brush with steel wool or pumice and lacquer	Black

TABLE 27—*continued*

METAL Treated	Materials	Temperature	Remarks on process	Colour obtained
	(18) 1 oz. pot. dichromate ½ oz. nitric acid (Sp. G. 1·2) 1 gallon water	140–160° F.	Yellow first but in 2–4 min. mahogany. Longer time gives deeper colour. Polish on buff with tripoli	Brown
	(19) ½ oz. copper sulphate 2 oz. ferric chloride 10 fl. oz. hydrochloric acid 1 gallon water	As hot as possible	Immerse and dry without rinsing. Repeat till desired colour	Antique brown
	(20) 40 oz. pot. permanganate 3 oz. ferric chloride 15 oz. cadmium nitrate 1 gallon water	180° F.	Add few drops of nitric acid to clear. Preferably immediately after plating	Deep brown
	(21) 2 oz. ammon. molybdate 4 oz. ammon. chloride 1 oz. pot. nitrate 1 oz. boric acid 1 gallon water	140–160° F. Few seconds	Suitable for zinc	Black
Zinc	(22) 16 oz. nickel sulphate 4 oz. zinc sulphate 2 oz. sod. thiocyanate 1 gallon water	Cold	Electrolytic. 2 amps./sq. ft. Nickel or stainless steel anodes	Black
	(23) 100 gms. nickel ammon. sulphate 10 gms. sod. thiosulphate 15 gms. sod. citrate	Cold	Electrolytic. Current density 0·1–15 amps./ft. 3*p*H 6·4	Green
	(24) 200 gms. sod. dichromate 6-9ml. sulphuric acid 1 litre water	70° F. 10–20 secs.	"Cronak" process. Rinse and dry below 50° C.	Golden

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TABLE 28. FURNITURE FINISHING—Specimen Schedules

No.	Class of Work	Type of Finish.	Staining	Filling	First Coating	Matching	Finishing Operations
1.	Medium grade oak bedroom suites.	Bright.	Stain to shade with proprietary base stain applied by rag. Allow to dry for two hours.	Rag apply appropriate brand and shade of paste filler, wiping clear all excess. Allow to dry overnight.	Spray apply one coat of cellulose sanding sealer or possibly spray polish. Dry for 1 hr. and sand lightly.	Any unevenness in strike of base colour may be pulled together by spray matching stain applied through fine nozzle.	One or two sprayed coats of nitro-cellulose bright wood lacquer, allowing 30 min. between coats. After 45 hours, final coat should be lightly papered and then pulled over with the specific pull-over solution for the lacquer in use
2.	Good quality walnut and mahogany bedroom suites.	Full bright.	As for (1), though not usually necessary on mahogany.	As for (1).	Spray apply one coat of cellulose sanding sealer, dry for 1 hr. and sand lightly.	As for (1).	Two sprayed coats of best quality nitro-cellulose bright wood lacquer, with possibly a third on fronts and tops, allowing 30 min. between coats. After overnight drying, flat thoroughly fronts and tops and then pull over, using the specific pull-over solution for this lacquer. After 4-5 hours, fronts and tops may be revived with a mildly abrasive polishing cream applied on a soft cloth or lamb's-wool mop.
3.	Reproduction oak furniture of most types.	Satin.	As for (1), choosing suitable dark oak colour.	As for (1), if required.	Spray apply one coat of cellulose sanding sealer, dry for 1 hr. and sand lightly.	As for (1), applying greater depth of colour in some areas to heighten effect.	One sprayed coat nitro-cellulose satin wood lacquer, the finish being left from spray.
4.	Dining and fireside chairs.	Bright.	Stain to shade with proprietary base stain applied by spray to even strike or by rag. Dry overnight.	Unlikely to be required.	Spray apply one coat of cellulose sanding sealer or spray polish. Dry for 1 hr. and sand lightly.	As for (1) if required.	One sprayed coat nitro-cellulose bright wood lacquer, pulling over, after 4-5 hours, the most prominent areas.
5.	Dining suites.	Bright or off-gloss.	As for (1).	As for (1).	As for (2).	As for (1).	One or two sprayed coats of best quality nitro-cellulose bright wood lacquer, allowing 30 min. between coats. After 4-5 hours, the final coat may be lightly papered and pulled over. After 2-3 hours the pulled-over surface may be revived with a mildly abrasive polishing cream, or alternatively oversprayed with a semi-gloss, satin or matt wood lacquer.
6.	Natural finished occasional and other furniture of oak, sycamore and other light coloured timbers.		—	—	Spray apply one coat water-white cellulose lacquer and dry for 1 hr. Lightly papered.	—	One or two further thin sprayed coats of water-white cellulose lacquer. After 2-3 hours, the final coat may be lightly pulled over, then rubbed down with the finest grade of steel wool and lightly waxed.

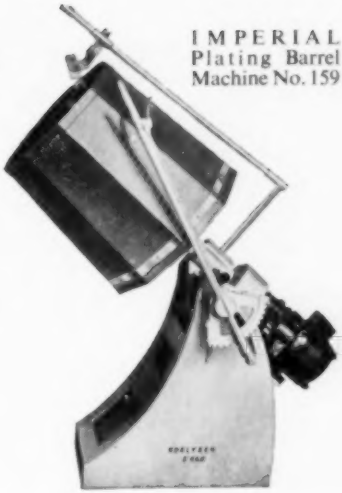
For every type

OF PLANT AND EQUIPMENT

for

ELECTRO-PLATING AND METAL PROCESSING

BARREL MACHINES FOR PLATING, TUMBLING, SHAKING, SCOURING AND BURNISHING



IMPERIAL
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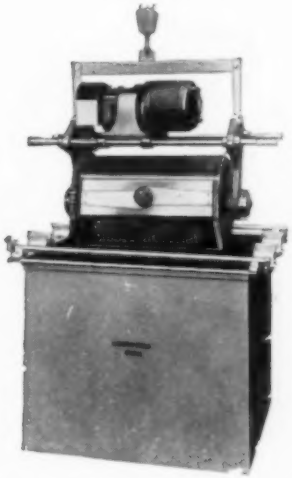

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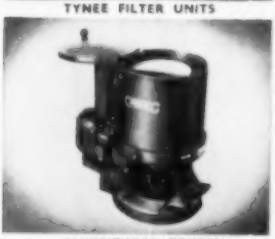
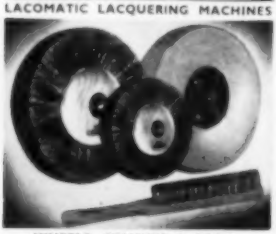


CENTRIFUGAL DRYERS

LACOMATIC LACQUERING MACHINES



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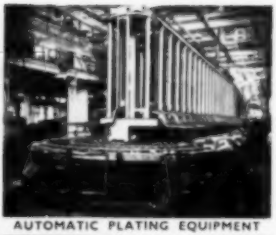

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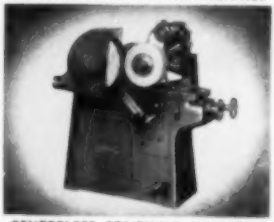

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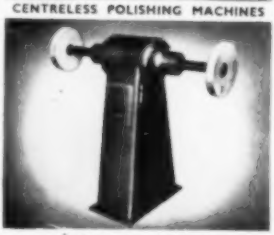

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TABLE 29. MISCELLANEOUS WOOD FINISHING—Specimen Schedules

No.	Class of Work	Type of Finish.	Staining	Filling	First Coating	Matching	Finishing Operations
7.	Walnut or mahogany radio cabinets.	Full bright.	If required, stain to shade with proprietary base stain applied by rag. Allow to dry for two hours.	Rag apply appropriate brand and shade of fast drying paste filler, wiping clean all excess. Allow to dry for 2 hr.	One sprayed coat of hard burnishing wood lacquer. Dry for 1 hr. and lightly paper to remove nibs.	Any unevenness in strike of base colour may be pulled together by spray matching stain applied through fine nozzle.	Two or three further sprayed coats of hard nitro-cellulose burnishing wood lacquer, allowing one hour between coats. After overnight drying of final coat, it may be well flatted down, by hand or mechanically. Thereafter the surface may be buffed on a mechanical polishing machine, using an abrasive cutting compound and finishing with a polishing cream, or may be pulled over with a semi-dry rubber and then finished with the same polishing cream.
8.	Pianofortes.	Full bright.	Use a water base stain of the non-grain raising type applied on a rag, building up until the required depth of shade is produced. Dry for 24 hours and lightly paper.	Rag apply oil-base paste filler of desired shade, wiping clean all excess. Allow to dry for 2-3 days.	Fad in with top grade french polish. A very thin sprayed coat is a permissible alternative. Dry for 1 hr.	Colour in where necessary with a coloured polish, applied on a soft brush. Dry for 1 hr.	Spray apply four coats of hard nitro-cellulose burnishing wood lacquer, allowing two hours between first three coats; and flat thoroughly between third and fourth coat after overnight drying. Dry final coat for 2-3 weeks and pull over to a dead level surface. After a further's week's drying, the surface may again be flatted, using only the finest grade of abrasive paper, well lubricated to avoid scratches, and finally hand polished by conventional french polish method.
9.	Nursery furniture.	Full bright.	If required, stain by spray with proprietary base stain. If timber is not too "snappy," stain application may be dip on cot sides, etc., wiping excess clean by rag.	Not usually required.	One sprayed coat of cellulose sanding sealer, either clear or lightly tinted. Paper after 1 hr.	Not usually required.	Spray apply one coat of nitro-cellulose bright wood lacquer. Panel work may be pulled over with appropriate pull-over solution, though most areas are left from spray.
10.	Kitchen cabinets and nursery furniture, pigmented colours.	Full bright.	—	See first coating.	Spray apply one coat cellulose filling sealer, usually pigmented white because most finishing colours are pastel shades. Dry for 1-2 hr. and paper smooth.	—	Spray apply two coats of nitro-cellulose glossy pigmented lacquer in required pastel shade. Leave finish as from spray.

TABLE 30

LUMINESCENT COATINGS
(Of Non-Radioactive Materials)

Luminescent materials have the property of converting radiant energy of short wave length, popularly called black light, to visible light.

- **Fluorescent Materials** (only emit light while being activated)
  - **Inorganic Pigments** (zinc or cadmium sulphide plus vehicle)
    - Spirit soluble rhodamine, thioflavine, eosine, phosphoric auromine (in binders)
    - Oil soluble sodium red lake, rhodamine, tungstate lake auramine tungstate lake
  - **Organic Dyes** (Synthetics)
- **Phosphorescent Materials** (continue to glow after exciting source is withdrawn)
  - **Type A** After-glow is very bright less than 2 hr.; zinc sulphide or cadmium sulphide, or combination.
  - **Type B** After-glow is NOT bright but endures 2 to 12 hr. as after-glow; cadmium fluoride, strontium sulphide or combination

BINDERS: Air-drying types; alkyd resin oil type, cellulose nitrate or acetate, chlorinated rubber, damar resin, vinyl resin, methacrylates, etc. Baking types of binders; alkyd, melamine alkyd, urea alkyd resins.

COLOURS: Green through yellow, orange, deep red; visible light colours do not correspond to the fluorescent colours.

TABLE 31

COMPARATIVE DRYING TIME OF COLOURED LACQUERS BY INFRA-RED LAMPS

Drying Time Min.	Colours ; on 22 gauge steel, with lamps at 12-in. distances from worl, 11-in. centres at 2 w per. sq. in.				
	Black	Grey	Green	Blue	White
5	325°F.	310°F.	295°F.	285°F.	275°F.
10	350°F.	325°F.	315°F.	310°F.	300°F.
15	360°F.	340°F.	330°F.	325°F.	310°F.
5	Drying temperature on 20 gauge, black lacquer, at stated wattage per sq. in.				
1·2 W per sq. in.	210°F.	—	—	—	—
2·0 W per sq. in.	275°F.	—	—	—	—
6·0 W per sq. in.	500°F.	—	—	—	—

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TABLE 32

COMPARISONS OF PHYSICAL FACTORS OF A FEW SYNTHETIC LACQUERS AND INFRA-RED DRYING DATA

Coating and Resins	Radiant Drying		Resistance to the Listed Condition						Comparative Physical Factors			
	Temperature °F	Time	Heat	Sunlight	Water	Marring	Weak Acids and Alkalies	Mineral Solvents	Flexural Strength	Adhesion	Tough-ness	Colour Retention
Phenol formaldehyde ..	Air dry	4 to 5 hr.	E	F	G	E	G	E	G	G	E	G
Urea formaldehyde ..	250 to 325	9 to 4 min.	G	E	F	E	F	E	E	E	G	E
Urea formaldehyde and Alkyd resin	225 to 300	6 to 3 min.	•	•	•	•	•	•	•	•	•	•
Urea formaldehyde and with synthetic	Air dry		•	•	•	•	•	•	•	•	•	•
Alkyd	Air dry, 160	½ min.	G	E	F-G	F	G	G	G	G	G	E
Melamine	300 to 400	6 to 3 min.	G	G	G	G	G	G	F	G	F	E
Melamine and Alkyd mixture	180 to 200	10 to 4 min.	•	•	•	•	•	•	•	•	•	•
Vinyl chlorides	Room to 200	5 to 60 min.	F-G	E	F	F	G	G	G	P-F	F-G	G

mixture	180 to 200	10 to 4 min.	•	•	•	•	•	•	•	•	•	•

Vinyl chlorides	Room to 200	5 to 60 min.	F-G	E	F	F	G	G	G	P-F	F-G	G
Methacrylates	Room to 200	5 to 60 min.	G	G	G	G	G	G	G	G	F-G	G
Chlorinated rubber ..	Room		P	F	F-P	F-G	G	P	E-G	F-G	G	P
Nitrocellulose lacquers ..	Air dry, 110	10 to 2 min.	F	E	P-F	F-G	F	F	G	G	E	P
Mixed lacquers	Air dry, 150 to 200	45, 15, 6 min.	•	•	•	•	•	•	•	•	•	•
Synthetics with 20 to 35 p.c. oil	Air dry, 200	30, 35, 16 min.	•	•	•	•	•	•	•	•	•	•
Synthetics with 50 p.c. oil	Air dry 225 to 250	2 to 3 hr. 1½, 1 hr.	•	•	•	•	•	•	•	•	•	•
Synthetics with cobalt and lead driers	Less than above	Less than above	•	•	•	•	•	•	•	•	•	•
Synthetics with over 50 p.c. oil	Air dry, 225 to 250	2½ hr., 40, 30 min.	•	•	•	•	•	•	•	•	•	•
Shellac	Special for hot applications	Gun	F	E	P-F	F-G	P	P	G	F-P	F-P	P
Oil-base paints	300	60				Properties depend on formulation						

• *Physical characteristics to be modifications of the merits and demerits of the components.*
E = Excellent; G = Good; F = Fair; P = Poor.

TABLE 33

OUTSTANDING PROPERTIES AND USES OF SYNTHETIC COATINGS

Type of Coating	Method of Film Formation	Type of Dry			Outstanding Properties	Commercial Application
		Air	Force	Stove		
Unmodified Alkyd ..	Condensation	—	—	X	Thermoplasticity and dielectric strength with mica, etc.	Laminated paper, cloth, or mica sheets for electrical insulation
Resin-Modified Alkyd ..	Evaporation	X	—	—	Hardness, clear-rubbing, print-resistance	Furniture lacquers
Oil- or Acid-Modified Alkyd	Condensation and oxidation	X	X	X	Exterior durability, toughness, adhesion	Motor-car, truck, and refrigerator finishes
Phenolic Modified Alkyd	Oxidation and condensation	X	—	X	Improved water and alkali resistance	Washing-machine finish
Straight Phenolic ..	Condensation and polymerisation	X	—	X	Water-vapour and chemical resistance	Automobile primers and surfacers
Modified Phenolic ..	Condensation and polymerisation	X	—	—	Abrasion and water-resistance with wood oil	Marine finishes
Nitrocellulose . ..	Evaporation	X	X	—	Speed of dry	Leather finishes
Ethyl Cellulose ..	Evaporation	X	X	—	Heat resistance low-temperature flexibility	Cable lacquer coatings
Cellulose Acetate ..	Evaporation	X	X	–	Low flammability	Interior trim aircraft lacquers

TABLE 33—*continued*

Cellulose Acetate ..	Evaporation	X	X	—	Low flammability	Interior trim aircraft lacquers
Mixed Cellulose Esters	Evaporation	X	—	—	Exterior durability of clear coatings	Protection of bronze
Urea-Formaldehyde ..	Condensation		—	X	Chemical and abrasion resistance, colour	Refrigerator finishes
Melamine	Condensation	—	—	X	Heat resistance	Stove-parts finishes
Vinyl	Evaporation	X	-	—	Resistance to continuous water immersion	Swimming-pool coatings
Acrylic Ester	Evaporation	—	—	X	Resistance to abrasion and flexing	Textile and rubber cloth coatings
Polystyrene . ..	Evaporation	X	—	—	High dielectric strength	Coatings for electrical insulation
Ester Gum	Inter-esterification with compounded oils and resins	X	—	—	Low cost—general miscibility	Wood oil varnishes
Esterized Copals ..		X	—	—	Exterior durability in long oil varnish	Long oil spar varnishes
Mixed Abietic-Maleic Esters		X	—	—	Quick solvent release	Nitrocellulose sanding sealers
Pentaerythrityl Abietate		X	—	—	Pale colour, quick dry	Linseed or dehydrated castor oil varnishes
Chlorinated Rubber ..	Evaporation	X	X	—	Removal of surface tack, increase chemical resistance	Fortification of air-drying alkyds
Depolymerised Rubber..	Evaporation	X	—	—	Resistance to strong alkali	Inside lining for caustic tanks

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TABLE 34

PROPERTIES OF COMMON SOLVENTS

Solvent	*Boiling Range ° C.*	*Flash Point (Open Cup) ° F.*	*Wt./Gal. at 20° C. lb.*
ALCOHOLS			
Methyl Alcohol	64– 66	52	7·90
Ethyl Alcohol	74– 79	65	7·90
Isopropyl Alcohol	82– 83	67	7·85
Secondary Butyl Alcohol	96–103	88	8·05
Isobutyl Alcohol	107–111	111	8·04
Normal Butyl Alcohol	116–119	111	8·10
Secondary Amyl Alcohol	117–124	110	8·05
Amyl Alcohol (mixed isomers)	121–139	111	8·14
Methyl Amyl Alcohol	131–132	114	8·05
Hexyl Alcohol	144–156	145	8·30
Octyl Alcohol	182–202	178	8·30
ESTERS			
Methyl Acetate (82%)	53– 55	5	9·06
Ethyl Acetate (85%)	70– 80	35	8·85
Isopropyl Acetate (85%)	82– 90	45	8·55
Isopropyl Acetate	84– 94	35	8·70
Diethyl Carbonate (91%)	87–127	85	9·56
Secondary Butyl Acetate (82%)	105–127	88	8·55
Isobutyl Acetate	114–118	88	8·70
Normal Butyl Acetate (90%)	119–127	88	8·75
Ethyl Lactate	119–176	140	10·00
Secondary Amyl Acetate (92%)	121–144	111	8·62
Normal Butyl Propionate	124–171	105	8·73
Amyl Acetate (mixed isomers) (84%)	127–155	111	8·61
Methyl Amyl Acetate	140–147	113	8·55
Methyl Cellosolve Acetate	143–145	132	9·98
Collosolve Acetate	145–166	122	9·13
Isopropyl Lactate	149–167	130	2.86
Hexyl Acetate (91%)	157–164	135	8·75
Butyl Cellosolve Acetate	188–192	110	9·44
Octyl Acetate	195–203	180	8·25
Methyl Carbitol Acetate	203–212	180	10·04
Carbitol Acetate	211–220	225	10·01
Butyl Carbitol Acetate	236–249	260	9·85

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TABLE 34—*continued*

	Boiling Range ° *C.*	*Flash Point (Open Cup)* ° *F.*	*Wt./Gal at 20° C* *lb.*
ETHER ALCOHOLS			
Methyl Cellosolve	121–126	105	9·66
Cellosolve	133–137	111	9·30
Isopropyl Cellosolve	140–143	125	9·06
Butyl Cellosolve	163–172	165	9·00
Methyl Carbitol	190–194	200	10·04
Carbitol	189–203	205	10·02
Butyl Carbitol	220–231	230	9·56
Benzyl Cellosolve	254–258	265	10·07
KETONES			
Acetone	55– 57	0	7·93
Methyl Ethyl Ketone	77– 82	34	8·05
Diethyl Ketone	100–104	59	8·14
Methyl Propyl Ketone	101–107	60	8·05
Methyl Isobutyl Ketone	112–118	74	8·00
Messityl Oxide (86%)	117–139	90	8·55
Dipropyl Ketone	138–144	120	8·15
Methyl Normal Amyl Ketone	147–153	115	8·16
Diacetone Alcohol	153–160	135	9·35
Diisobutyl Ketone	164–169	145	8·05
Acetonylacetone	188–193	190	9·73
HYDROCARBONS			
Benzene	78– 81	<5·5	8·26
Petroleum Naphtha	96–129	31	7·34
Toluene	109–111	44	8·68
Xylene	127–159	80	8·61
Hi-Flash Naphtha	149–193	115	8·60
Mineral Spirits	152–207	140	7·69
V. M. and P. Naphtha	168–210	120	7·64
MISCELLANEOUS			
Ethylene Dichloride	82– 84	70	12·55
Turpentine (Gum Spirits)	154–201	110	8·69
Turpentine (Steam Distilled)	155–173	115	8·54

Except where noted alcohols, esters, ether alcohols and ketones are 95% or greater purity. Data based on "Lacquer Solvents in Commercial Use," Doolittle, Ind. and Eng. Chem., 27, No. 10.

TABLE 35

RELATIVE RATES OF EVAPORATION OF SOME OF THE COMMON LIQUIDS USED IN NITROCELLULOSE LACQUERS

(*The evaporation rate or butyl acetate is taken as a standard, with the value of* 100.)

	Name of Liquid	*Relative Evaporation Rate*
1.	*Low-boilers*:	
	Ethyl acetate	525
	Isopropyl acetate	435
	Methyl-ethyl-ketone	465
2.	*Intermediate*:	
	Ethyl alcohol	205
	Isopropyl alcohol	205
	Toluene	195
	Secondary butyl acetate	180
3.	*High-boilers*:	
	Methyl-isobutyl-ketone	145
	Butyl acetate	100
	1-Nitropropane	100
	Butanol	45
	Xylene	68
4.	*Super-high-boilers*:	
	Butyl lactate	6
	Butyl "Cellosolve"	10

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TABLE 36—PHYSICAL CONSTANTS OF OILS

Oil	Acid Number Range	Iodine Number Range	Weight Per Gal. Pounds
LINSEED :			
Raw	0·5–6·0	165–190	9·33
Refined	0·0–16·0	170–192	9·33
Boiled	2·5–8·0	115–190	9·33–9·97
Heat Bodied	1·0–22·0	80–188	9·33–9·97
Blown	2·0–12·0	115–175	9·33–9·98
DEHYD. CASTOR	1·6–10·0	100–150	9·30–9·82
OITICICA	3·0–6	140–148	9·73
TUNG	0·9–8	154–177	9·42
PERILLA	2·0	185–206	9·30
RAPESEED	0·25–10·0	55–106	9·14–9·80
TALL	155–180	140–165	9·60–9·96
SOYA BEAN :			
Raw	0·2–4·0	128–140	9·25
Refined	0·1–6·0	125–140	9·14–9·36
Bodied	1·0–11·5	60–120	9·37–10·0
FISH :	0·2–8·0	165–195	9·21–9·36
Heat Bodied	0·8–100	50–170	9·37–10·14
Blown	6·0–84·0	60–136	9·46–10·14

TABLE 37

PHYSICAL PROPERTIES OF TYPICAL COMPOSITIONS OF VINYL CHLORIDE AND CHLORIDE-ACETATE POLYMERS

	Rigid Vinyl Chloride-Acetate	Plasticised Chloride-Acetate	Plasticised Vinyl Chloride
Moulding qualities	Excellent	Good	Good
Compression moulding (°F	280–325	250–340	290–350
Injection moulding (°F)	280–300	250–340	300–350
Specific gravity	1·34–1·37	1·2–1·6	1·2–1·6
Tensile strength (psi)	8,000–10,000	1,000–9,000	1,000–9,000
% Elongation	—	To 500 %	To 500 %
Softening temperature (°F)	140	—	—
Volume resistivity	10 ohm-cm	—	10 ohm-cm
Dielectric strength	650	300	600
Dielectric constant			
60 cycles	3·26	9·0	6·5
Million cycles	3·08	4·2	—
Power factor			
60 cycles	0·008	0·08	0·08
Million cycles	0·017	0·10	—
Water absorption			
24 hours	0·05–0·15	—	0·05–0·6
Effect of age	None	May harden by vaporisation of plasticiser	
Sunlight	Darkens slightly	Darkens	Darkens
Resistance to :			
Weak acids	Excellent	Good	Good
Strong acids	Excellent	Very good	Very good
Weak alkalis	Excellent	Very good	Very good
Strong alkalis	Very good	Very good	Very good
Alcohols	Excellent	Very good	Very good
Ketones	Dissolves	Dissolves	Dissolves
Esters	Dissolves	Dissolves	Dissolves
Aromatic hydro-carbons	Swells	Swells	Swells
Mineral oils	Excellent	Excellent	Excellent
Vegetable oils	Excellent	Excellent	Excellent

TABLE 38—NATURAL RESIN PRODUCTS

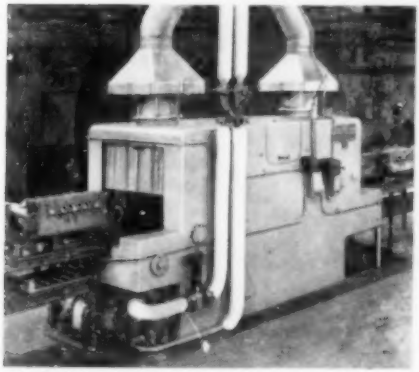
Product	Resin	Oil	Length	Procedure
Architectural Enamel	Damar	Alkyd, Linseed		Cold-cut blend
Baking Finishes	Congo, Batu, East India	Tung, D.C., L.	8–20	Varnish cook
Exterior Varnish	Congo, Batu, East India, Kauri, Manila	Tung, D.C., L.	25–50	Varnish cook
Flat Varnish	Batu, East India	Tung, D.C., L.	8–25	Cooked below 500° F. Use prebodied L. or D.C.
Floor Varnish	Congo, Batu, East India, Pontianak, Kauri	Tung, D.C., L.	18–28	Varnish cook
Fume Resistant Enamels	Damar	Blown Soya	3–5	Cold-cut
Furniture Varnish	Congo, Batu, East India, Kauri, Boea	Tung/Linseed	6–15	Varnish cook
General Purpose Varnish	Congo, Batu, East India, Kauri	Tung, D.C., L.	15–25	Varnish cook
Inks—roto	Batu, East India	Linseed	0–5	Cold-cut
Inks—typographic	Damar, Congo, Kauri	Linseed	15–30	Varnish cook
Insulating Varnish	Kauri, Congo	Tung/Linseed	20	Varnish cook
Label Varnish	Manila, Pontianak	Blown Castor	1–5	Spirit cut
Lacquers—Ethylcellulose	Congo, Damar, Manila			Cold-cut addition
Lacquers—Nitrocellulose	Damar, Congo, Manila, Elemi			Cold-cut addition
Overprint Varnish (Spirit)	Manila	Blown Castor	1–5	Spirit cut
Overprint Varnishes	Damar, Congo	Tung/Linseed	15–25	Varnish cook
Porch and Deck Varnish	Congo, Batu, East India, Pontianak, Kauri	Tung, D.C., L.	18–28	Varnish cook
Rubbing Varnish	Congo, Batu, East India, Kauri	Tung/Linseed	6–10	Varnish cook
Sealer (Wood, plaster, etc.)	Manila, Pontianak	Blown Castor	1–5	Spirit cut
Traffic Paint (Spirit)	Manila	Blown Castor	3–5	Spirit cut
Traffic Paint (Cold-cut)	Batu	Soya, Linseed	5–8	Cold-cut
Traffic Paint	Batu, East India, Congo	Tung, Linseed	5–15	Varnish cook
Wax Polish	Manila			Ammonia Solution and Carnauba emulsion
Wrinkle Finish	Congo	Tung, Blown Tung	10–25	Undercooked Varnish

The most practical plant for Cleaning METAL PARTS

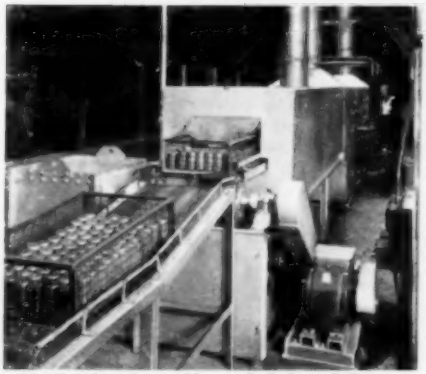
PRIOR TO ASSEMBLY, and BEFORE and AFTER REPAIRS

Dawson

DE-GREASING AND CLEANING MACHINES

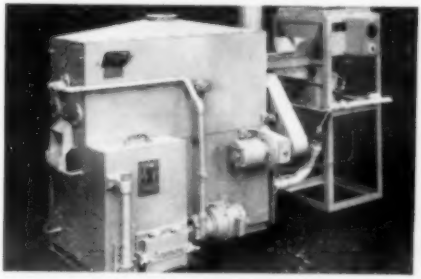


A model 'A' machine, washing parts of motor car engines prior to assembly.

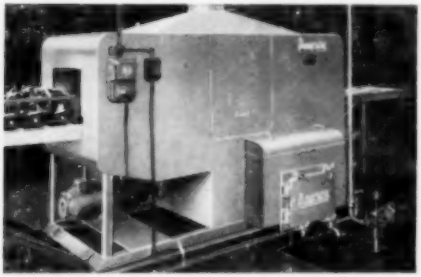


Supplied for the washing and drying of Tractor parts. Crank Shafts, Sumps, Pressings, etc.

Dawson Metal Parts cleaning machines are supplied for all branches of the engineering industry. Their chief characteristics are robustness of design, small number of working parts and simplicity of operation. Space only permits the illustration of four of the many types of machines built for quick economical washing and drying of Metal Parts.



A Rotary Drum machine for removing swarf and grease from small components.



A 'Junior' type machine supplied to a Midlands Motor Car Works.

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TABLE 39—GENERAL DESCRIPTION OF NATURAL RESINS

Name of Resin	Softening Point °C.	Melting Point °C.	Specific Gravity At 20° C.	Direct Acid No.	Solubility Type	Insolubility Type
Kauri Pale No. 1	90	128	1·04	64	Alcohols and ketones	Aryl and aliphatic hydrocarbons
Brown No. 1	120–125	152–161	1·04	57–68	Alcohols and ketones	Aryl and aliphatic hydrocarbons
Congo A216 — Assorted amber, bold & large nubs—partly scraped	85–104	160–200	1·06–1·07	95–102	None	All solvents
A217 — Assorted top grades, amber colour, hard, fully scraped	88–104	174–200	1·06–1·07	95–102	None	All solvents
B25 — Pale straw coloured, mostly hard, fully scraped	75–91	143–176	1·06–1·07	92–96	None	All solvents
White & Ivory Congo No. 1 Water White transparent	87	128	1·05–1·07	100	None	All solvents
No. 14 Selected fully scraped Ivory	75–91	143–144	1·06–1·07	92–94	None	All solvents
Straw coloured Congo No. 3 Selected Pale Straw Bold	89	176	1·0[illegible]	96	None	All solvents
Pale Congo—No. 26 Bold Pale Chips	90	144	1·06	96	None	All solvents
Amber Congo —No. 6 Pale Amber Bold	101	206	1·05	96	None	All solvents
Sorts & Selections No. 12 —Selected Sorts Bold	86	174	1·06	101	None	All solvents
Miscellaneous Gum Elemi	PLASTIC		1·03	20–35	Aryl hydrocarbons and esters	Aliphatic hydrocarbons, alcohols and ketones
Red Gum Coarse (Accroides or Yacca)	75	110–128	1·34	—	Alcohols	Aryl and aliphatic hydrocarbons
Sandarac Gum	100–130	135–150	1·05–1·09	117–155	Alcohols	Aryl and aliphatic hydrocarbons

All these values are average and not quantitive in reference to any particular lot.

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TABLE 39—*continued*

GENERAL DESCRIPTION OF NATURAL RESINS

Name of Resin	Softening Point °C.	Melting Point °C.	Specific Gravity At 20° C.	Direct Acid No.	Solubility Type	Insolubility Type
Pale East India Macassar Bold-Hiroe	101–112	127–156	1·03–1·04	16–21	Aryl hydrocarbons, hydrogenated aliphatic hydrocarbons	Alcohols, esters, ketones
Pale East India, Singapore Bold	109–128	147–156	1·04–1·05	20–27	Aryl hydrocarbons, hydrogenated aliphatic hydrocarbons	Alcohols, esters, ketones
Batu East India Scraped	111–132	168–180	1·00–1·05	18–20	Aryl hydrocarbons, hydrogenated aliphatic hydrocarbons	Alcohols, esters, ethers, ketones, terpenes
Black East India Bold Scraped	114–125	160–164	1·04	20	Aryl hydrocarbons, hydrogenated aliphatic hydrocarbons	Alcohols, esters, ethers, ketones, terpenes
Batavia Damar A/E Standard	70–76	102–107	1·04–1·06	25–31	Aryl and aliphatic hydrocarbons, terpenes	Alcohols, esters
E Seeds	74–75	99–102	1·04–1·06	27–33	Aryl and aliphatic hydrocarbons, terpenes	Alcohols, esters
Singapore Damar No. 1	67	115	1·04–1·05	17	Aryl and aliphatic hydrocarbons, terpenes	Alcohols, esters
Manila (Macassar) MA Soft Blocky	77–88	121	1·06–1·07	127–134	Alcohols, esters, ketones	Aryl and aliphatic hydrocarbons
Loba C Bold Pale Chips	81–88	114–123	1·07–1·08	139–141	Alcohols and ketones	Aryl and aliphatic hydrocarbons
DBB Pale Chips	78–88	120–129	1·06–1·07	135–143	Alcohols and ketones	Aryl and aliphatic hydrocarbons
Singapore Manila White Split Chips	94	126	1·07	120	Alcohols and ketones	Aryl and aliphatic hydrocarbons
Manila (Philippine) S.S. Extra Bold Pale Scraped	86	123	1·06	107	Alcohols and ketones	Aryl and aliphatic hydrocarbons
Pontianak Bold Scraped	87–135	135–161	1·07–1·08	113–118	Alcohols and ketones	Aryl and aliphatic hydrocarbons, esters
Boea Manila Hard Bold White	79	130	1·07	118	Alcohols and ketones	Aryl and aliphatic hydrocarbons, esters and ethers

All these values are average and not quantitative in reference to any particular lot.

PAINT DATA—Effect of Oils on Speed of Drying

TABLE 40

RELATIVE EFFECT OF DIFFERENT OILS ON SPEED OF DRYING, COLOUR AND GLOSS RETENTION.

Oil	*Iodine Number*	*Speed*	*Colour*	*Gloss Retention*
Tung	170	↑		↑
Linseed	180			
Dehyd. Castor	155			
Soya	135			
Cottonseed	110			
Peanut	108			
Olive	85			
Castor	85			
Coconut	9		↓	

TABLE 41

VARIATION OF FILM PROPERTIES OF ALKYD RESINS RELATED TO THE RATIO OF ALKYD

Alkyd Ratio	*Set*	*Hard*	*Dura. and Air*	*Dry Bake*	*Colour*	*Alcohol*	*Tolerance to Aliphatic Hydrocarbon*	*Brushing*
100	↑	↑	↓	↑	↑	↑	↓	↓

TABLE 42

TINTING AND HIDING POWER OF WHITE PIGMENTS

Pigment	Tinting Strength	Hiding Power, Sq. Ft. per Lb.	Hiding Unit
Basic lead carbonate	100	15	1·00
Basic lead sulphate	85	13	0·87
Zinc oxide	200	20	1·33
Zinc oxide 35% leaded	170	20	1·33
Lithopone	260	27	1·80
Titanium and barium pigment A	380	40	2·67
Titanium and barium pigment B	430	46	3·07
High-strength lithopone ..	400	44	2·93
Titanated strength lithopone ..	400	44	2·93
Titanium-calcium pigment ..	450	48	3·20
Titanium magnesium pigment	440	47	3·13
Zinc sulphide	540	58	3·87
Lead titanate	570	60	4·00
Titanium oxide	1150 (best)	115 (best)	7·67 (best)

It will be noted that titanium oxide has nearly double the tinting strength and hiding power as compared to the next nearest in quality.

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Cellomold Cellulose Acetate
Styron Polystyrene
Rigidex Polyethylene

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TABLE 43

APPROXIMATE FATTY ACID COMPOSITION OF SOME OILS

	Number of Double bonds	Cotton-seed	Soya-bean	Lin-seed	China wood	Castor
Saturated acids (%) ..	0	25	12	9	4	2
Oleic acid (%)	1	27	30	15	5	7
Linoleic acid (%) ..	2	48	53	26	1	3
Linolenic acid (%) ..	3	—	5	50	—	—
Elaeostearic acid (%) ..	3 (Triply Conjugated)	—	—	—	90	—
Ricinoleic acid (%) ..	—	—	—	—	—	88

TABLE 44

EXTENDER PIGMENTS

Pigment	App. Chemical Composition	Refractive Index	Specific Gravity	Oil Absorption
Silicate Pigments				
Silica	SiO_2	1·55	2·6	25·0
Diatomaceous Silica	SiO_2	1·40–1·50	1·95–2·35	25·0–150·0
Clay	Al_2O_3, $2SiO_2$, $2H_2O$	1·56	2·60	36·0
Pyrophyllite ..	Al_2O_3, $4SiO_2$, $2H_2O$	1·588	2·85	—
Talc	$2MgO$, $4SiO_2$, H_2O	1·59	2·85	27·0
Mica				
Muscovite ..	K_2O, $3Al_2O_3$, $6SiO_2$, $2H_2O$	1·59	2·5–3·0	47·5
Phlogopite ..	K_2O, $6MgO$, Al_2O_3, $6SiO_2$, $2H_2O$	1·606	2·5–3·0	24·0
Barium Sulphate Pigments				
Ground Barytes ..	$BaSO_4$	1·64	4·476	6·0
Blanc Fixe	$BaSO_4$	1·64	4·35	14·0
Calcium Sulphate Pigments				
Gypsum	$CaSO_4$, $2H_2O$	1·53	2·35	21·0
Anhydrite	$CaSO_4$	1·59	2·95	25·0
Precipitated Calcium Sulphate	$CaSO_4$	1·59	2·95	50·0
Calcium Carbonate Pigments				
Precipitated Types				
Colloidal ..	$CaCO_3$	1·63	2·68	55·0
High Oil Absorption	$CaCO_3$	1·63	2·68	40·0
Low Oil Absorption	$CaCO_3$	1·63	2·68	17·0
Surface Treated	$CaCO_3$	1·63	2·65	15·0
Natural Types				
Calcite				
Water Ground	$CaCO_3$	1·60	2·71	15·0–6·5
Dry Ground ..	$CaCO_3$	1·60	2·71	9·0
Limestone ..	$CaCO_3$	1·60	2·71	10·5
Imported Chalk	$CaCO_3$	1·60	2·71	12·5

Factors Influencing the Smoothness of Sprayed Lacquer Films

TABLE 45

PRINCIPLE FACTORS INFLUENCING THE SMOOTHNESS OF SPRAYED LACQUER FILMS.

1. Speed of evaporation of the volatiles in the lacquer.
2. The solvency conditions of the lacquer, i.e. the relative proportions of solvents and diluents present in the lacquer film throughout the drying period.
3. The viscosity of the lacquer at the spray gun.
4. The effectiveness of the atomisation.
5. The temperature of the lacquer, of the spraying air, and of the atmosphere in which the lacquer film is dried; these influence the speed of evaporation of the volatiles in the spray cone and from the drying film, and they thereby effect the length of the "flowing" period.
6. The strength of the air currents in the spray hood and the length of time which the coated article remains in the forced draught there; these factors also act by influencing the speed of evaporation of the volatiles from the drying film.
7. The number of coats applied: two and three coat applications tend to give rougher films than single coat jobs.
8. The gloss of the finish: orange peel and similar defects show up more in a glossy finish than in a flat one.
9. Variations in the conditions and technique of spraying, as follows:
   a. Excessive distance between the spray nozzle and the surface increases the loss of volatiles in the spray cone, and is a strong factor toward decreased smoothness.
   b. The use of excessive proportions of atomising air similarly tends to increase the evaporation of the volatiles in the spray operation, while the opposite use of insufficient spraying air produces bad results through poor atomisation.
   c. Within practical limits, the greater the thickness of the liquid coat, the longer the drying time and better the smoothness of the film. Excessive thickness, however, may lead to sagging.
   d. The use of the widest spray fan is naturally advisable to save time and to reduce the number of laps. The extra volume of atomising air which is used to bring this about, however, increases the loss of the volatiles during the spray operation, and thus reduces the flowing period.
   e. Rapid speed of spraying is naturally desirable, but when carried to excess it tends to produce thin films, unless the supply of lacquer is increased correspondingly, and it naturally makes the control of the spraying more difficult.
10. The shape and size of the article being coated and proper illumination during the spray operation; these are very important in so far as they influence greatly some of the factors in 9, above.
11. The nature of the surface being coated—wood, under-coat, or polished metal; the nature of the resin used in the lacquer, the alkyds for example being worse than ester gum in respect to the smoothness of the finish.
12. The general skill and co-operative attitude of the spray man. These naturally control the factors in 9, and other similar factors, to a considerable extent.

TABLE 46

PERMEABILITY OF MOISTURE THROUGH ORGANIC COATINGS

Coating	*Milligrams of H_2O/0·001 in. film/sq. in./24 hours.*
Cellophane (not moisture-proof)	300
Cellulose acetate	300
Vinyl acetate	115
Vinyl chloracetate	27
Linseed oil	80
Long oil varnishes	36-48
Long oil varnish + Aluminium powder	14
Short oil varnishes	17-24
Single-pigment paints	29-56
Nitrocellulose lacquers	15-87
Orange shellac	·6
Asphaltic coating	5

TABLE 47—DROP IN AIR PRESSURE

From various lengths of ¼ inch and 5/16 inch Air Hose used with Spray Gun equipped with Air Cap consuming approximately 12 c. ft. of air per minute at 60 pounds pressure

Size of Air Hose Inside Diameter	Air Pressure Drop at Spray Gun					
	5 foot length	10 foot length	15 foot length	20 foot length	25 foot length	50 foot length
¼ inch	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
At 40 lb. pressure	6	8	9½	11	12¾	24
At 50 lb. pressure	7¼	10	12	14	16	28
At 60 lb. pressure	9	12½	14½	16¾	19	31
At 70 lb. pressure	10¾	14½	17	19½	22¼	34
At 80 lb. pressure	12¼	16½	19½	22½	25½	37
At 90 lb. pressure	14	18¾	22	25¼	29	39½
5/16 inch						
At 40 lb. pressure	2¼	2¾	3¼	3½	4	8½
At 50 lb. pressure	3	3½	4	4½	5	10
At 60 lb. pressure	3¾	4½	5	5½	6	11½
At 70 lb. pressure	4½	5¼	6	6½	7¼	13
At 80 lb. pressure	5½	6¼	7	8	8¾	14½
At 90 lb. pressure	6¼	7½	8¼	9¼	10½	16

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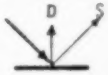
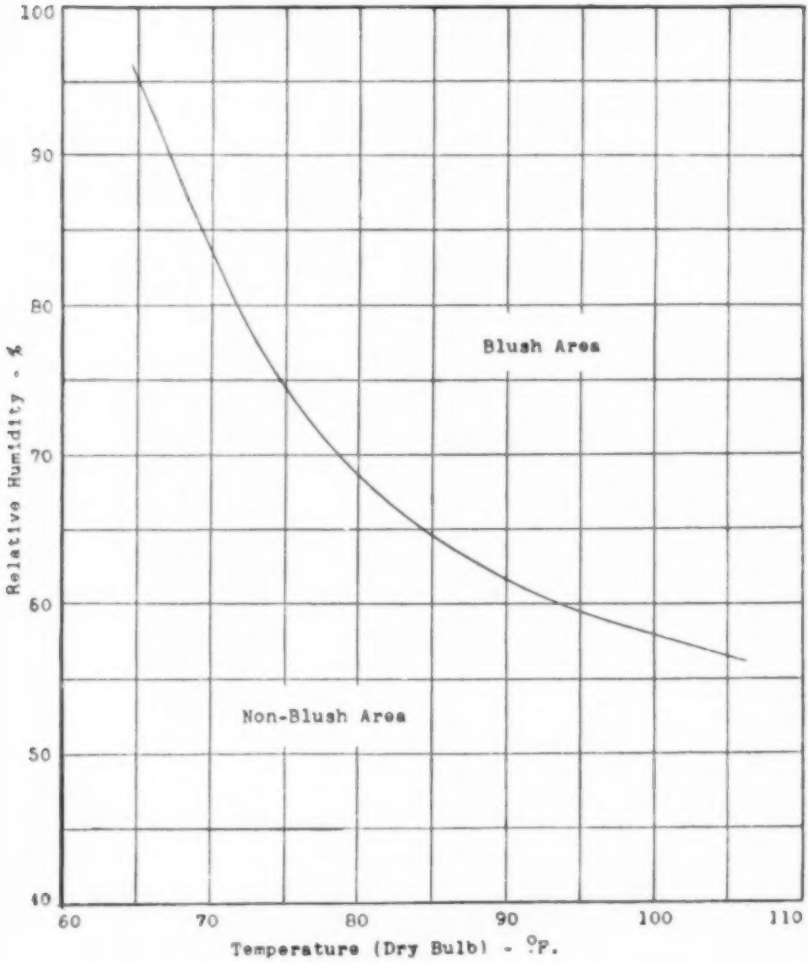
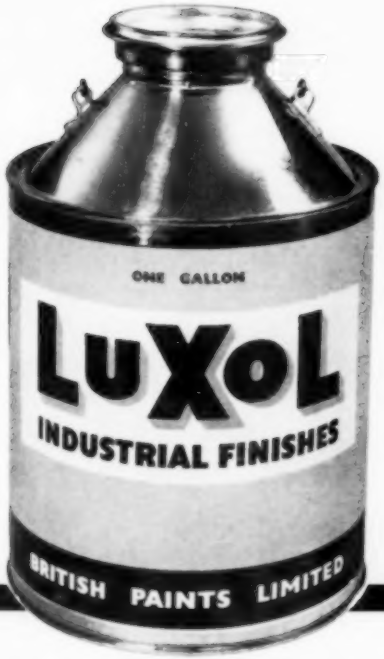
GLOSS CLASSIFICATION CHART

TYPE OF GLOSS	APPEARANCE ATTRIBUTES	DIAGRAMMATIC REPRESENTATION	CLASSES OF SURFACES INVOLVED	GLOSS RANGE INVOLVED
SPECULAR GLOSS	SHININESS, BRILLIANCE OF HIGH LIGHTS		PAINTS, SURFACES OF MODERATE GLOSSINESS	MEDIUM GLOSS
SHEEN	SHININESS AT GRAZING ANGLES		MAT PAINTS, PAPERS AND LOW-GLOSS SURFACES	LOW GLOSS
CONTRAST GLOSS	CONTRAST BETWEEN SPECULARLY REFLECTING AREAS AND OTHER AREAS		PAPERS, MAT AND SEMI-MAT FINISHES, WHITE AND LIGHT-COLORED MATERIALS	LOW GLOSS
ABSENCE-OF-BLOOM GLOSS	ABSENCE OF SMEAR OR EXCESS SEMI-SPECULAR REFLECTION ADJACENT TO REFLECTED HIGH LIGHTS		SURFACES IN WHICH REFLECTED HIGH LIGHTS AND IMAGES MAY BE SEEN	HIGH GLOSS
DISTINCTNESS-OF-IMAGE GLOSS	THE DISTINCTNESS AND SHARPNESS OF THE MIRROR IMAGES	NOT YET MEASURED AS FUNCTION OF DIRECTIONAL REFLECTANCE	FINISHES ENAMELS, LACQUERS, GLAZES, AND ALL SMOOTH IMAGE REFLECTING SURFACES	HIGH GLOSS
SURFACE-UNIFORMITY GLOSS	SURFACE UNIFORMITY, FREEDOM FROM VISIBLE NONUNIFORMITIES	NOT MEASURED AS FUNCTION OF DIRECTIONAL REFLECTANCE	GLOSS AND SEMI-GLOSS SURFACES OF ALL TYPES	MEDIUM TO HIGH GLOSS

BLUSHING CHART

The following chart shows a typical blush curve for a representative lacquer.





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PAINT manufacturers will supply the following information:

(i) The area covering capacity in square yards per gal.

(ii) Approximate weight per gal.

The following tables give the surface area in sq. yards per ton of steel sections and the surface area in sq. yards per 100 ft. run. By multiplying these figures by the factor

$$\frac{\text{density of steel}}{\text{density of other metal}}$$

the figures for brass, aluminium, etc., may be arrived at. Assuming a paint covers 100 sq. yards per gal. on bare steel of good surface, with a coarse surface an allowance of 25 per cent. should be made giving a covering power of 75 yards per gal.

A section in steel 2 in. × 2 × ¼ in. offers 51·5 sq. yards per ton. Therefore, one gal. of paint will coat

$$\frac{75}{51{\cdot}5} = 1{\cdot}46 \text{ tons of rough steel section.}$$

The same section offers 7·3 sq. yd. per 100 ft. run. Therefore, one gal. of paint will coat

$$\frac{75}{7{\cdot}3} = 10{\cdot}3 \times 100 = 1{,}030 \text{ ft. run.}$$

ROLLED STEEL JOISTS

Size A × B In.	Weight per foot lbs.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
3 × 1½	4	62·3	11·1
3 × 3	8·5	44·0	16·7
4 × 1½	5	62·3	13·9
4 × 3	10	41·3	18·5
4½ × 2	7	50·1	15·6
4½ × 1½	6·5	52·5	15·2
5 × 2½	9	45·8	18·4
5 × 3	11	41·4	20·4
5 × 4½	20	29·0	25·9
6 × 3	12	41·5	22·2
6 × 4½	20	31·1	27·8
6 × 5	25	26·5	29·6
7 × 3½	15	38·7	25·9
7 × 4	16	38·9	27·8
8 × 4	18	36·8	29·6
8 × 5	28	26·7	33·4
8 × 6	35	23·7	37·0
8 × 8	37·84	26·3	44·5
9 × 4	21	33·5	31·4
9 × 7	50	19·1	42·6
10 × 4½	25	31·9	35·6
10 × 5	30	27·6	37·0
10 × 6	40	22·8	40·7
10 × 8	55	19·6	48·2
10 × 8	70	15·4	48·2
12 × 5	30	30·4	40·7
12 × 5	32	28·5	40·7
12 × 6	44	22·6	44·3
12 × 6	54	18·4	44·3
12 × 8	65	17·9	52·0
13 × 5	35	27·2	42·5
14 × 5½	40	25·9	46·2
14 × 6	46	23·4	48·1
14 × 6	57	18·9	48·2
14 × 8	70	17·8	55·7
15 × 5	42	24·7	46·4
15 × 6	45	24·9	50·0
16 × 6	50	23·3	52·0
16 × 6	62	18·8	52·1
16 × 8	75	17·7	59·3
18 × 6	55	22·6	55·5
18 × 7	75	17·7	59·3
18 × 8	80	17·6	63·0
20 × 6½	65	21·1	61·3
20 × 7½	89	16·3	64·8
22 × 7	75	19·9	66·7
24 × 7½	95	17·0	72·2
24 × 7½	100	16·2	72·4

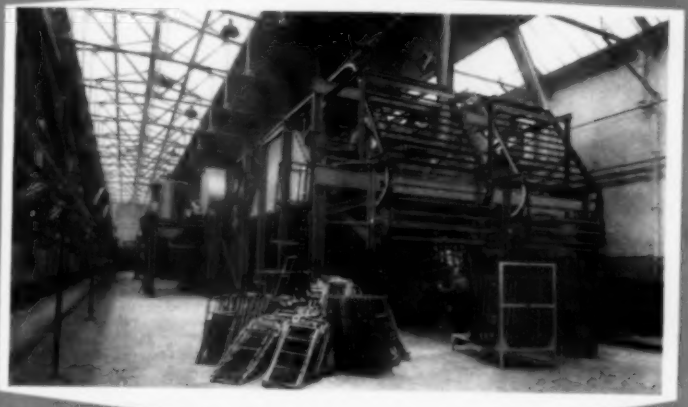
CHANNELS

Size A × B In.	Weight per foot lbs.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
3 × 1½	4·6	54·1	11·1
4 × 2	7·09	46·7	14·8
5 × 2½	10·22	40·4	18·5
6 × 3	12·41	40·1	22·1
6 × 3	16·51	30·1	22·2
6 × 3½	16·48	32·6	24·0
7 × 3	14·22	37·8	24·0
7 × 3½	18·28	31·7	25·9
8 × 3	15·96	36·3	26·9
8 × 3½	20·21	30·8	28·1
9 × 3	17·46	35·6	27·7
9 × 3½	22·27	29·7	27·5
10 × 3	19·28	34·3	29·5
10 × 3½	24·46	28·8	31·4
11 × 3½	26·78	27·9	33·4
12 × 3½	26·37	29·8	35·1
12 × 4	31·33	26·4	36·9
13 × 4	33·18	26·2	38·8
15 × 4	36·37	26·2	42·8
17 × 4	44·34	23·4	46·3

CORRUGATED SHEETING

Thickness	Corrugations	Painting Area 1 Side Only per 100 sq. ft.	per ton
16 BG	5 × 5 in.	111 sq. ft.	
,,	8 × 3 ,,	116 ,,	
,,	6 × 4 ,,	114 ,,	97·7 sq. yds.
,,	7 × 4 ,,	115 ,,	
,,	6 × 5 ,,	112 ,,	
,,	10 × 3 ,,	112 ,,	
18 BG	5 × 5 ,,	111 ,,	
,,	8 × 3 ,,	116 ,,	
,,	6 × 4 ,,	114 ,,	123·3 ,,
,,	7 × 4 ,,	115 ,,	
,,	6 × 5 ,,	112 ,,	
,,	10 × 3 ,,	112 ,,	
20 BG	5 × 5 ,,	111 ,,	
,,	8 × 3 ,,	116 ,,	
,,	6 × 4 ,,	114 ,,	158·3 ,,
,,	7 × 4 ,,	115 ,,	
,,	6 × 5 ,,	112 ,,	
,,	10 × 3 ,,	112 ,,	
22 BG	8 × 3 ,,	116 ,,	193·3 ,,
,,	10 × 3 ,,	112 ,,	
24 BG	8 × 3 ,,	116 ,,	233·3 ,,
,,	10 × 3 ,,	112 ,,	
26 BG	8 × 3 ,,	116 ,,	310·0 ,,
,,	10 × 3 ,,	112 ,,	
28 BG	8 × 3 ,,	116 ,,	333·3 ,,
,,	10 × 3 ,,	112 ,,	

INDUSTRIAL OVENS



BALLARD

THE NAME - CONVEYING - OVENS

F. J. BALLARD & CO. LTD. TIPTON ENGLAND

TEES

Size A × B In.	Thickness In.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
1 × 1	¼	100·2	3·7
	⅜	70·2	
1½ × 1½	¼	68·8	5·6
	⅜	52·7	
2 × 2	¼	52·0	7·5
2½ × 2½	¼	50·8	
	⅜	41·3	9·3
	½	34·9	
3 × 3	¼	41·0	
	⅜	34·6	11·1
	½	30·0	
4 × 3	¼	34·0	12·9
	⅜	26·0	
4 × 4	¼	33·9	14·8
	⅜	25·9	
5 × 3	¼	33·8	14·8
	⅜	25·9	
5 × 4	¼	25·8	16·7
	⅜	20·9	
6 × 3	¼	33·7	16·7
	⅜	25·7	
6 × 4	¼	25·5	18·5
	⅜	20·7	
6 × 6	¼	25·4	22·2
	⅜	20·5	

EQUAL ANGLES

Size A × B In.	Thickness In.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
½ × ½	⅛	107·3	2·8
	¼	58·7	
1 × 1	⅛	102·6	
	¼	71·5	3·7
	⅜	55·1	
1¼ × 1¼	⅛	103·5	
	¼	71·2	4·7
	⅜	54·8	
1½ × 1½	⅛	69·5	
	¼	53·2	5·6
	⅜	43·8	
1¾ × 1¾	⅛	68·4	
	¼	52·3	6·4
	⅜	42·6	
2 × 2	⅛	67·6	
	¼	51·5	
	⅜	41·9	7·3
	½	35·6	
2½ × 2½	⅛	67·9	
	¼	51·7	
	⅜	41·9	8·3
	½	35·5	
2½ × 2½	⅛	51·2	
	¼	41·5	9·2
	⅜	35·1	
2¾ × 2¾	⅛	50·8	
	¼	34·6	10·1
	⅜	26·6	
3 × 3	⅛	50·9	
	¼	41·2	11·1
	⅜	34·7	
	½	26·6	

Size A × B In.	Thickness In.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
3½ × 3½	¼	41·0	
	⅜	34·5	13·0
	½	26·4	
4 × 4	¼	21·5	
	⅜	34·0	
	½	26·0	
	⅝	21·1	14·8
	¾	17·9	
4½ × 4½	¼	33·9	
	⅜	25·8	16·6
	½	21·4	
5 × 5	¼	17·7	
	⅜	33·9	
	½	25·7	18·6
	⅝	20·9	
6 × 6	¼	17·6	
	⅜	33·6	
	½	25·5	22·2
	⅝	20·6	
	¾	15·0	
7 × 7	⅜	25·3	
	½	20·4	26·0
	⅝	17·2	
	¾	14·8	
8 × 8	⅜	20·3	
	½	17·1	29·6
	⅝	14·8	
	¾	13·0	
9 × 9	½	22·9	33·4
	⅝	17·0	

UNEQUAL ANGLES

Size A × B In.	Thickness In.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
2 × 1½	⅛	68·4	5
	¼	52·3	6·5
	⅜	42·6	
2½ × 1½	⅛	68·6	
	¼	52·3	7·5
	⅜	42·6	
2½ × 2	⅛	67·9	
	¼	51·7	
	⅜	42·0	8·4
	½	35·5	
3 × 2	⅛	67·3	
	¼	51·1	
	⅜	41·5	9·3
	½	34·6	
3 × 2½	⅛	51·3	
	¼	41·5	10·2
	⅜	35·0	
3½ × 2½	⅛	50·9	
	¼	41·2	11·1
	⅜	34·7	
3½ × 3	⅛	50·5	
	¼	40·9	12·0
	⅜	34·4	
4 × 2½	⅛	50·5	
	¼	50·9	12·0
	⅜	34·4	
4 × 3	⅛	41·0	
	¼	34·5	13·0
	⅜	26·4	
4 × 3½	⅛	40·7	
	¼	34·2	13·9
	⅜	26·1	
	½	21·3	
4½ × 3	⅛	40·7	
	¼	34·2	13·9
	⅜	26·1	
5 × 3	⅛	40·5	
	¼	34·0	14·8
	⅜	26·0	

Size A × B In.	Thickness In.	Surface Area sq. yds. per ton	Surface Area sq. yds. per 100 ft. run
5 × 3½	⅛	40·7	
	¼	34·1	
	⅜	26·0	15·9
	½	21·1	
5 × 4	⅛	33·9	
	¼	25·8	
	⅜	21·0	16·7
	½	40·4	
6 × 3	⅛	33·9	
	¼	25·8	16·7
	⅜	21·0	
6 × 3½	⅛	40·3	
	¼	33·8	
	⅜	25·7	17·6
	½	20·9	
6 × 4	⅛	33·9	
	¼	25·7	
	⅜	20·9	18·5
	½	17·6	
6 × 5	⅛	33·8	
	¼	25·6	19·5
	⅜	20·8	
7 × 3½	⅛	25·6	
	¼	20·7	20·4
	⅜	17·3	
7 × 4	⅛	33·7	
	¼	25·6	21·3
	⅜	20·7	
7 × 5	⅛	25·5	
	¼	20·6	22·2
	⅜	17·4	
8 × 4	⅛	25·3	
	¼	20·4	25·9
	⅜	17·2	
8 × 6	⅛	14·9	
	¼	25·3	
	⅜	20·4	
9 × 4	¼	17·2	24·0
	⅜	14·9	

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THE NEW SUNDSTRAND ORBITAL SANDER has speeds up to 5,500 cycles per minute, is ideal for fast sanding on large or small areas and its true orbital action permits sanding up to edges, mouldings and into tight corners. It has a very light weight, fits snugly into the hand, and has counterbalanced parts to minimise fatiguing vibration. A palm lever operates both air and water, for wet sanding, by slight downward pressure. Both air consumption and air pressure required are low. Send for details of this machine and of the Sundstrand 'straight-line' Sanders for the finest finishes.

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M-W.165

FINISHING MATERIAL COSTS

1. Mileage per Gallon

$$M = \frac{(W)\ (Ps)}{(Dc)\ (Tc)\ (433)}$$

M—mileage per reduced (ready to apply) gallon of finishing material—square feet.

W—weight per gallon of reduced finishing material—pounds. This datum is most easily obtained with an hydrometer. The specific gravity reading multiplied by 10 gives the weight per gallon in pounds.

Ps—per cent. by weight of non-volatile solids in reduced finishing material.

Carefully weigh a small sample of the reduced finishing material into a tared weighing dish and dry to constant weight at about 100° F. The weight of the dried sample divided by the weight of the original sample and multiplied by 100 gives the per cent. by weight of non-volatile solids.

Dc—density of the cured film of finishing material. Accurately weigh and measure the area and thickness of a clean, flat panel. Apply a uniform coat of the finishing material to one side of the panel and, in the case of a baking material, bake for the regular schedule, or, in the case of an air drying material, dry to constant weight. Accurately weigh and measure the thickness of the finished panel.

The density of the cured film from the following equation

$$Dc = \frac{(w)}{(a)\ (t)\ (16{\cdot}39)}$$

w—weight of cured film (by difference)—grams.

a—area of panel—square inches.

t—thickness of cured film (by difference) inches.

16·39—constant.

Tc—thickness of cured film of finishing material which is acceptable for protection and/or decoration—inches.

433—constant.

2. Cost per Gallon

$$C = \frac{(Pt)\ (Ct) + (100 - Pt)\ (Cp)}{100}$$

C—cost per reduced gallon of finishing material—shillings.

Pt—per cent. by volume of added reducer in reduced finishing material.

Ct—cost per gallon of reducer—shillings.

Cp—cost per gallon of unreduced finishing material—shillings.

SPRAY OPERATOR EVALUATION

1. Time Utilisation Factor

Time utilisation factor is the ratio of the amount of finishing material actually sprayed to the amount which could be sprayed in the same time with the gun in continuous operation. It is expressed by the equation:

Eq. 1

$$Tu = \frac{Wa}{Wp}$$

Tu—time utilisation factor

Wa—finishing material actually sprayed per hour—pounds.

Wp—finishing material possible per hour—pounds.

Example.

An operator sprays 6·0 pounds of lacquer per hour (Wa). At the adjustment used, the gun in continuous operation could deliver 10·0 pounds of lacquer per hour (Wp).

Substituting these data in Equation 1, the time utilisation factor is:

$$Tu = \frac{6{\cdot}0}{10{\cdot}0} = 0{\cdot}6$$

That is, the operator is spraying 60 per cent. of the time. During 40 per cent. of the time the gun is not functioning.

2. Material Utilisation Factor

Material utilisation factor is the ratio of the amount of finishing material actually applied to the amount sprayed. It is expressed by the following equation:

Eq. 2

$$Mu = \frac{(W)\ (N)}{(Wa)\ (Ps)}\ (100)$$

Mu—Material utilisation factor.

W—cured finishing material on average piece—pounds.

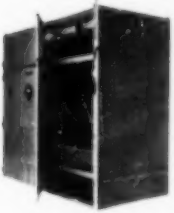
N—number of pieces finished per hour.

Wa—(as above).

AC TO DC CONVERSION *by*

E C C

MERCURY-ARC RECTIFIERS



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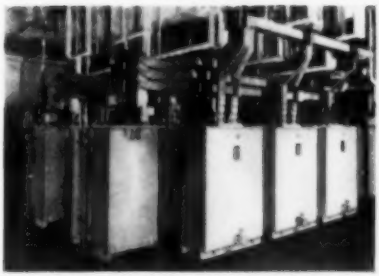

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THE ELECTRIC CONSTRUCTION COMPANY LTD.
BUSHBURY ENGINEERING WORKS WOLVERHAMPTON

Ps—per cent. by weight of non-volatile solids in finishing material.
100—constant.

Example.

A spray operator finishes 450 pieces per hour (N), using 6·0 lb. of lacquer (Wa). The lacquer contains 25 per cent. by weight of non-volatile solids (Ps). After drying, the lacquer on the average piece was found to weigh 0·0012 lb. (W). (*Note.* Find (W) by weighing piece before finishing and after finish is applied and cured.)

Substituting these data in Equation 2, the material utilisation factor is:

$$Mu = \frac{(0{\cdot}0012)\ (450)}{(6{\cdot}0)\ (25{\cdot}0)}\ (100) = 0{\cdot}36$$

That is, of the material sprayed, 36 per cent. is useful while the remainder is lost in overspray.

3. Productivity Factor

Productivity factor is the ratio of the number of pieces actually finished to the number which could be finished in the same time if the gun were in continuous operation and there were no overspray losses, etc. It is the product of the time utilisation factor and the material utilisation factor and is expressed by the following equations:

Eq. 3

$$P = (Tu)\ (Mu)$$

Eq. 4

$$\text{or, } P = \frac{(W)\ (N)}{(Wp)\ (Ps)}\ (100)$$

P—productivity factor
(other factors as above)

Example.

Taking data from the above examples and substituting in Equations 3 and 4, the productivity factor is:

$$P = (0{\cdot}6)\ (0{\cdot}36) = 0{\cdot}216$$

$$\text{or, } P = \frac{(0{\cdot}0012)\ (450)}{(10{\cdot}0)\ (25{\cdot}0)}\ (100) = 0{\cdot}216$$

That is, the operator is producing 21·6 per cent. of the number of pieces theoretically possible.

(*Note.* In Equation 4 the quantity (Wa) does not appear and it is not necessary to make measurements of the amount of finishing material sprayed by the operator.)

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ELECTROSTATIC SPRAY PAINTING

The theory behind this process relates to electrostatic dust precipitation. Thus the articles to be painted are carried on an earthed conveyor into a highly ionised electrostatic field created between them and an electrode system charged to a negative static potential of 130,000 v. The coating material is atomised from a spray gun and pushed at low speed into the space between the electrode grid and the article.

At the high voltages used there is an invisible corona discharge from the fine wire of the electrode resulting in electron emission. The latter under the influence of the electric field strives to reach the electrode of opposite polarity—namely the work piece. Thus electrons colliding with the paint particles build up negative charge on this causing the paint particles to move to the earthed work piece, give up their charge and remain adherent to the article itself.

The main advantages of the process are:

(1) It is completely automatic, lending itself to conveyorisation.

(2) Paint savings of up to 50 per cent.

Figures from the Austin Motor Co. have been shown with the paint consumption for five car wheels by different paint application techniques, as follows:

Hand spray	1·2 pints.
Dipping	0·8 pints.
Electrostatic spray painting	0·35 pints

Fig. 1 shows a typical layout for motor-car wheels. The plant installation requires the following equipment:

(1) A spray booth with an exhaust system.

(2) An overhead conveyor enabling the work to be turned as it passes through the electrostatic field.

(3) Specially adapted spray guns often with a tangential air flow.

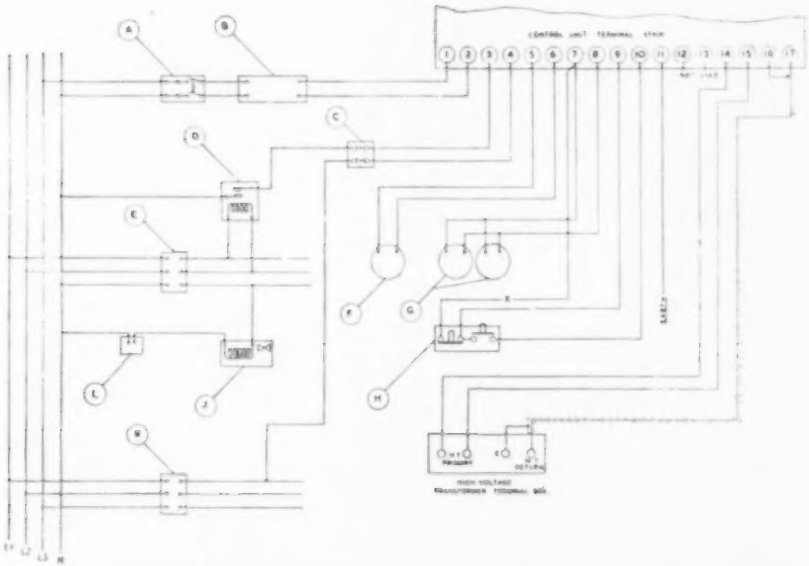


Fig. 1. Control unit wiring diagram. A, 250 volt 15 amps. fused isolator. B, constant voltage transformer. C, 2 pole, 5 amps. fuse box. D, Fan interlock relay. 400 volt coil. Contacts normally open. E, Fan contactor. F, One-stroke bell. G, remote warning lights. H, remote start-stop push-button switch. J, magnetic air valve (when available). K, conveyor contactor. L, Air-flow switch. To be supplied and installed as part of ventilating system.

When a guard fence is erected round the high voltage transformer the access door must operate an isolating switch into point marked x on cable 7.

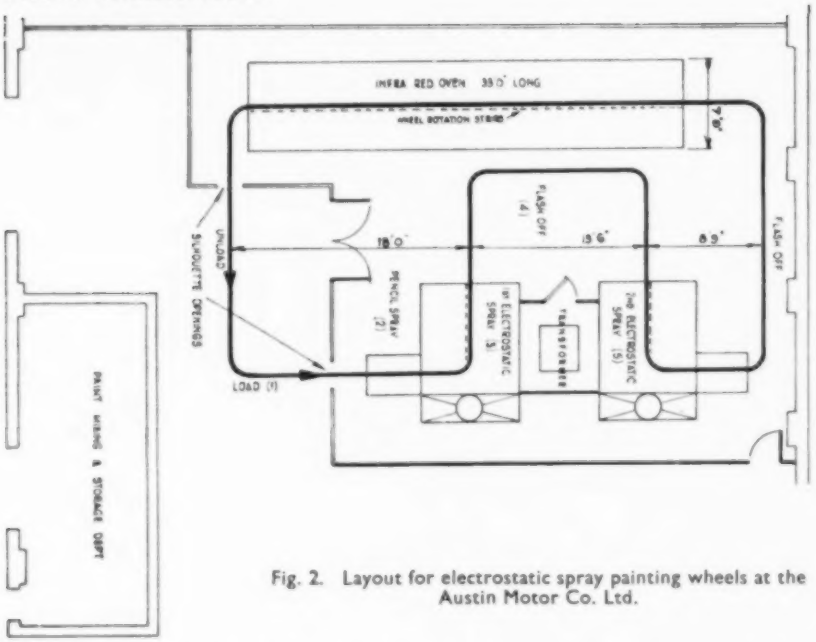


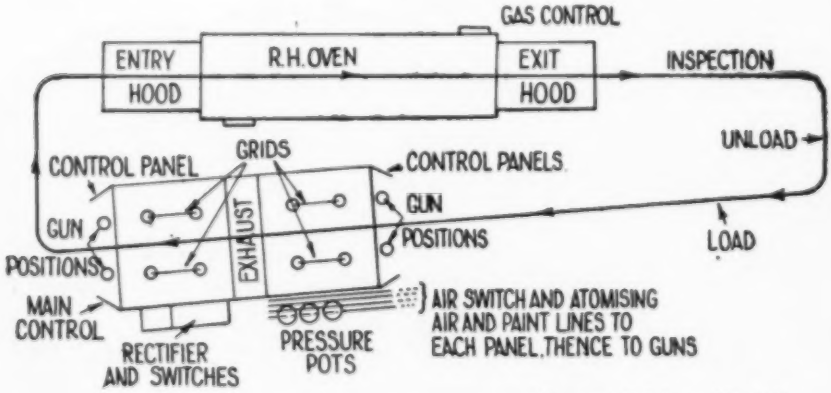
Fig. 2. Layout for electrostatic spray painting wheels at the Austin Motor Co. Ltd.

(4) A high voltage source such as an oil immersed transformer of the magnetic leakage type at 230 v. single phase 50 cycle input together with a series of selenium metal rectifiers giving a potential of 130,000 v. with a maximum of 7·5 milliamps.

The coating material is painted from an orthodox pressure feed system with liquid pressure regulator accurate to within $\frac{1}{4}$ lb. per sq. inch.

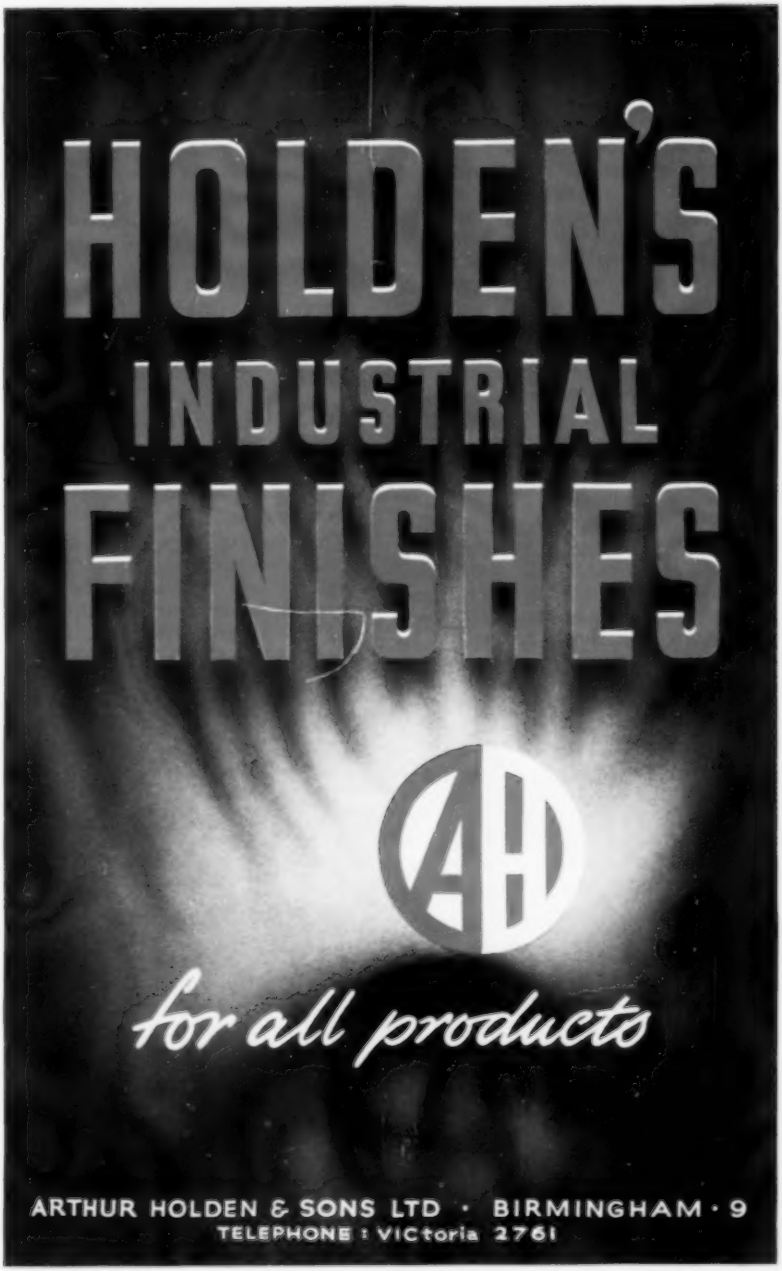
A controllable spray width up to a maximum of 24 in. measured at a distance of 24 in. from the nozzle tip is desirable. Small particle size of the spray is necessary and it should have a low forward velocity of 400-450 ft. per minute again measured at 24 in. from the nozzle tip.

The viscosities of the sprayed materials are normally lower than for other methods, being from 15-20 seconds using the No. 4 Ford cup.



(*Courtesy : G. Salter and Co. Ltd.*)

Fig. 3. Typical electrostatic spay layout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The output of the transformer cannot exceed 7½ milliamps, whilst with amperage available at the electrode is less than this. The transformer enclosure is kept locked and provided with an interlock switch which cuts the primary circuit before access is possible. Door closure alone does not restore contact. An outside switch must be operated.

Motors operating the ventilating system and the conveyor are electrically interconnected with the low tension supply to the transformer so that the electrostatic field is not established until both ventilation and conveyor are in operation, whilst failure of either cuts supply to the transformer.

An electronic spark guard cuts off low tension supply to the transformer when a sparking condition approaches due to a badly hung or swinging work piece.

Electrostatic Detearing

This resembles in principle electrostatic spray painting. An electrostatic field of high potential is maintained between the work piece and a charged electrode. Coating material is applied by dipping or flow coating. The goods then pass on an earthed conveyor, they are drained to a point when the last droplets are on the point of setting. They next pass over a large electrode system so that a strongly attractive electrostatic field is established between the drained off points of the goods and the electrode proper. Coating material from the drain off points is drawn off in the form of a fine spray in from ¼-2 minutes.

Fig. 4 shows an electrostatic detearing plant for this treatment of lamp shells.

The following points should be noted:

(1) Articles to be deteared must be carried over the grid at a constant distance from it—usually 8-10 in.
(2) Drain-off points should be of small radius—preferably less than ¼ in. and not shielded from the electrostatic field.
(3) The grid may be formed from a tubular metal frame covered with wire mesh.
(4) The length of the grid is determined by the speed of conveyor and detearing time.
(5) Modification may be necessary with thermoplastic dipping materials.

Doubtless the process of the supply increases the quality of finishing from the dipping process.

Flow Coating

This method of paint application is an intermediate stage between tumble finishing and dipping. The articles again on a conveyor pass through an enclosure where paint from a recirculating system flows over the articles from nozzles. The excess material is collected and returned to the circulating system. An example of the use of flow coating is the American application of the ground coat to motor-car wings.

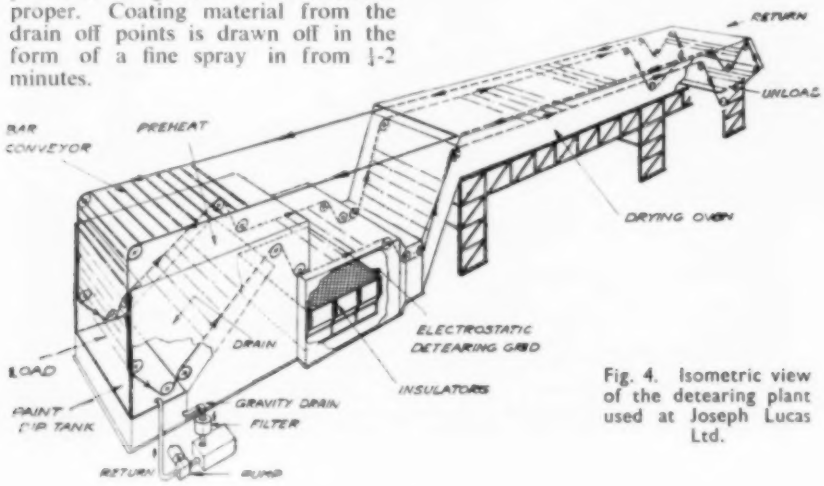

Fig. 4. Isometric view of the detearing plant used at Joseph Lucas Ltd.

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TABLE 48

METAL SURFACE TESTING EQUIPMENT AND PROCEDURES

Test For	Device or Process	Source of Supply
Abrasion	Timing the action of sanding (sand blasting) against a reciprocated specimen	Sand blasting equipment manufacturers
Adhesion	Erickson cup tester	Laboratory supply firms
Adhesion	Two specimens (plated metal) are soldered together and a tensile testing machine applied	Manufacturers of tensile testers
Adhesion	Ollard Roehl method for plated surfaces; a plated ring and plunger device	Laboratory supply firms
Ageing	Dry heat cabinet, 140° F. for 84 days, remove every 14 days and given an impact test	Laboratory supply firms
Blackness	Nigrometer, glossometer, reflectometer	Laboratory supply firms
Colour comparison	Spectrophotometer, reflectometer glossometer	Laboratory supply firms
Colour retention	Violet ray, fadometer, or test in direct sunlight	Laboratory supply firms
Corrosion resistance	Salt spray cabinet or actual exposure	Manufacturers of salt spray equipment
Drying time (paint film)	Sward hardness rocker (hardness and drying time)	Laboratory supply firms
Durability	Kauri reducter test	Laboratory supply firms
Elasticity	Knife peeling test	Home made
Fading	Weatherometer and humidity cabinet	Laboratory supply firms
Flexibility	Bend specimen over various size mandrels (Zuhr mandrels), see data on paint and lacquer	Home made
Hardness	Knoop indenter	Laboratory supply firms
Hardness	Microhardness testers for plated surfaces	Manufacturers of testing equipment
Hardness	Superficial hardness tester for thick plated work	Manufacturers of testing equipment
Drying and baking temperatures	Surface heat on baked work, surface pyrometer	Laboratory supply firms
Hiding power paint, etc.	Pfund cyptometor for paint and lacquer	Laboratory supply firms
Hiding power electrolytes	Haring cell for testing electrolytes	Laboratory supply firms
Hiding power	Hull cell or betn cathode tester	Laboratory supply firms
Impact resistance	Use a 16-lb. hammer, 2½-in. peen end-tipped to $\frac{1}{16}$-in. diam. with 24-in. impact fall	Home made
Internal Surface inspection	Polan borescope	Laboratory supply firms
Thickness	0·0001-in. metallographic plates for 0·001-in. micrometer	Laboratory supply firms
Thickness	Pfund-Feld paint thickness tester	Laboratory supply firms
Paint consistency (viscosity)	Ford cup tester, other viscosity cups, etc.	Laboratory supply firms
Wetting power	Tensiometer Du Nuoy	Laboratory supply firms

Pattern for Protection

AGAINST CORROSION

The upper picture on the right shows a gas works benzole plant finished with Epimac 702.

The lower picture illustrates a typical set of brewery storage tanks protected by Epimac 703.

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TABLE 49

The potential between any two surfaces in contact is the difference between the potentials shown in the table as measured against the Calomel Electrode.

Material	*Potential Against Calomel Electrode Volts*
Magnesium alloy sheet D.T.D. 118	1·58
Magnesium alloy sheet D.T.D. 120	1·58
0·001 in. zinc electroplated on mild steel S3	1·10
Zinc base die-casting alloy Masak 3	1·09
Zinc base die-casting alloy Durak	1·09
Galvanized iron	1·06
Zinc cadmium solder D.T.D. 221	1·04
Experimental high strength Al.-Zn.-Mn.-Mg. alloy	0·94
Aluminium alloy castings (14% Zn.) L5	0·91
Airscrew alloy X76S	0·89
Aluminium alloy castings D.T.D.424	0·80
0·001 in. cadmium electroplated on mild steel S3	0·78
Wrought aluminium alloy R.R.77	0·77
Aluminium sheet L16	0·76
Aluminium alloy castings (10–13% Si.) L33	0·75
Wrought aluminium alloy R.R.77 extrusion	0·74
Aluminium alloy sand or die-casting D.T.D.133	0·73
Aluminium coated aluminium alloy L38	0·73
Wrought aluminium alloy R.R.56	0·70
Mild steel S3	0·70
Cast iron grey	0·70
Tin-dipped steel	0·66
7% Mg.-Al. alloy Mg.7	0·61
Duralumin type alloy L3	0·60
0·0005 in. chromium electroplated on mild steel (S3)	0·53
2·5% silver lead solder	0·50
Tinman's solder Grade B	0·48
Tinman's solder Grade A	0·47
0·0005 in. tin electroplated on mild steel S3	0·47
Tin	0·46
0·00035 in. Cr. plated on 0·0015 in. Ni. plated on S3	0·43
Brass B5	0·30
0·0008 in. Cr. plated on 0·0015 in. Ni. plated on S3	0·25
Gunmetal B2	0·24
Inconel	0·24
Aluminium bronze	0·23
Phosphor bronze B8	0·22
Aluminium brass	0·21
Stainless steels S80, D.T.D.146 and D.T.D.171	0·05–0·35
German silver	0·19
Copper B15	0·18
Cupro-nickel 70: 30:	0·18
Al.-Ni.-Si. brass D.T.D.283	0·18
Monel	0·16
Nickel	0·14
Monel K.	0·13
45% Ni.-Cu. alloy D.T.D.237	0·13
Silver-plated copper	0·01

TABLE 50

CONVERSION OF FAHRENHEIT (F.) TO CENTIGRADE (C.) TEMPERATURES

°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
0 =	−17·8	55 =	12·8	110 =	43·3	165 =	73·9
5 =	−15·0	60 =	15·6	115 =	46·1	170 =	76·7
10 =	−12·2	65 =	18·3	120 =	48·9	175 =	79·4
15 =	− 9·4	70 =	21·1	125 =	51·7	180 =	82·2
20 =	− 6·7	75 =	23·9	130 =	54·4	185 =	85·0
25 =	− 3·9	80 =	26·7	135 =	57·2	190 =	87·8
30 =	− 1·1	85 =	29·4	140 =	60·0	195 =	90·6
32 =	0·0	90 =	32·2	145 =	62·8	200 =	93·3
35 =	1·7	95 =	35·0	150 =	65·6	205 =	96·1
40 =	4·4	100 =	37·8	155 =	68·3	210 =	98·9
45 =	7·2	105 =	40·6	160 =	71·1	212 =	100·0
50 =	10·0						

CONVERSION OF CENTIGRADE (C.) to FAHRENHEIT (F.) TEMPERATURES

°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.
0 =	32	30 =	86	55 =	131	80 =	176
5 =	41	35 =	95	60 =	140	85 =	185
10 =	50	40 =	104	65 =	149	90 =	194
15 =	59	45 =	113	70 =	158	95 =	203
20 =	68	50 =	122	75 =	167	100 =	212
25 =	77						

ELECTRIC POTENTIALS OF METALS

Principal Corrosion Resistant Metals

TABLE 51

Listed here are the principal corrosion resistant metals and recommendations as to the media they can be used with in manufactured products. The recommendations made are not intended to be complete. Rather they are made on the basis of economy, availability and relative ease of fabrication in cast forms. Where a metal is listed as impervious to a given corrosive agent, it is obvious that the metal is also capable of withstanding intermittent contact. Therefore, duplicate listings have not been made.

Material	Impervious To	Highly Resistant To
Aluminium	Acetylene, Air, Ammonia, Argon, Butadiene, Butane, Freon, Helium, Hexane, Hydrogen Sulphide, Methyl Chloride, Oxalic Acid, Oxygen, Ozone, Propylene	Acetic Acid, Acetic Anhydride, Gelatin, Lacquers, Sulphur
Brass	Diethylene	Acetaldehyde, Acetone, Acetylene, Air, Alcohol, Amyl Chloride, Argon, Arochlor, Benzaldehyde, Blood, Butadiene, Butane, Butylene, Carbon Tetrachloride, Carbonic Acid, Chloroform, Cyclopropane, Embalming Fluid, Ethane Gas, Ether, Ethyl Chloride, Ethylene Chlorohydrin, Ethylene Glycol, Ethylene Oxide, Formaldehyde, Freon, Gasoline, Glycol, Helium, Hexane, Hydrogen, Ketones, Latex, Lubricating Oils, Nitro Ethane, Nitrogen, Nitro Propane, Nitrous Oxide, Octane Iso, Oxygen, Ozone, Paraffin, Pentane, Potato Glucose Solution, Propylene, Propylene Dichloride, Propylene Glycol, Sulphur Di- and Trioxide, Tannic Acid, Turbine Oil, Urea, Vinyl Acetate, Water
Bronze	Calcium Chloride (salt), Sodium Chloride, Sea Water	Beer and Beer Mash, Benzol, Clay Slurries, Fatty Acid, Fish Oils, Glycerine, Kerosene, Lactic Acid, Methyl Chloride, Molasses, Naphtha, Pyroligneous Acid, Starch, Styrene, Waste Sulphite Liquor (zinc-free bronze), Trichlorethylene, Vegetable Oils, Whisky, Wine, Wort, Zein
Duriron	Alum (Alum Sulphate)	Calcium Hypochlorite, Chloroacetic Acid
Hastelloy "A"	—	—
"B"	—	—
"C"	—	Chromic Acid, Hydrobromic Acid
Iron		Acrolein, Ammonia, Ammonium Hydroxide, Ammonium Nitrate, Arochlor, Asphalt, Beet Sugar Liquors, Benzol, Black Sul. Liquor, Borax, Boric Acid, Boron Chloride, Butadiene, Butane, Butylene, Calcium Bisulphite, Calcium Hydroxide, Camphene, Carbon Bisulphide, Carbon Dioxide, Carbon Monoxide, Chlorine, Chlorine Dioxide, Chloro Ethane, Clay Slurries, Creosote, Cresols, Cresylic Acid, Cyanogen Chloride, Cyanohydrin, Cyclohexane, Cyclohexanone, Cyclopropane, Diethylene Glycol, Diphenyl, Dowtherm, Ethane Gas, Ethanolamine, Ether, Ethyl Acetate, Ethyl Acrylate, Ethyl Chloride, Ethyl Mercaptan, Ethylene Chlorohydrin, Furfural, Gasoline, Glue Glycerine, Heptane, Hydrogen Sulphide, Hydroguinone, Illuminating Gas, Kerosene, Latex, Lead Nitrate, Lime Slurries, Lithium Chloride, Magnesium Hydroxide, Magnesium

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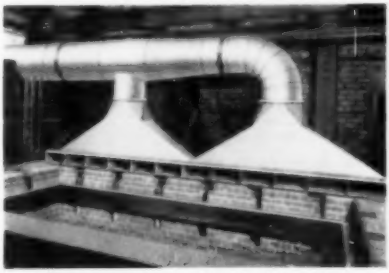

Fume extraction schemes in rigid P.V.C.

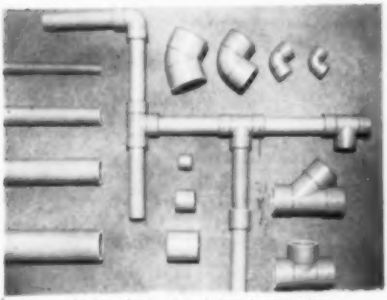

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TABLE 51—*continued*

Material	Impervious To	Highly Resistant To
Iron		Sulphate, Mercaptan, Mercury, Mesityl Oxide, Mixed (sulphuric and nitric) Acid, Molasses, Naphtha, Naphthalene, Nitro Benzine, Palmitic Acid, Phenylethyl-malonic Ester, Petrolatum, Phenolic Sulphonate, Phosgene, Phosphorous (liquid), Phthalic Anhydride, Pine Gum, Potassium Chloride, Potassium Chlorate, Potassium Cyanide, Potassium Hydroxide, Potassium Permanganate, Potassium Sulphate, Propane, Rosin Emulsions, Soap, Sodium Aluminate, Sodium Carbonate, Sodium Cyanide, Sodium Dichromate, Sodium Ethylate, Sodium Glutamate, Sodium Hydroxide (0-20 p.c.), Sodium Nitrate, Sodium Phosphate, Sodium Silicate, Sodium Sulphate, Sodium Sulphide, Steam, Stearic Acid, Stoddard Solvent, Styrene, Sulphuric Acid (93-98 p.c.), Tar, Terpene Monocyclic, Thionyl Chloride, Titanium Tetrachloride, Toluene, Trichlorethylene, Turpentine, Vegetable Oils, Vinyl Chloride, Wax, Xylene, Xylenol, Zein
Lead	Tin Tetrachloride	Alum, Ammonium Chloride, Chromic Acid, Sodium Sulphite, Spin Bath Solution, Sulphuric Acid (0-93 p.c.), Sulphurous Acid
Monel	Acetic-Anhydride, Ammonium Chloride, Ammonium Fluoride, Fluorine (anhydrous), Hydrogen Fluoride Gas, Magnesium Chloride, Phenol, Potassium Hydroxide, Potassium Sulphate, Propionic, Soap, Sodium Bisulphate, Sodium Hydroxide (above 20 p.c.), Sea Water, Zinc Chloride	Hydrofluoric Acid, Iodine, Phosphoric Acid
Nickel	Chloral, Phosphorous Oxychloride, Sodium Hydroxide (above 20 p.c.), Vinyl Resin Latex	—
Phosphor Bronze	—	Ammonium Phosphate, Ammonium Sulphate, Copper Sulphate, Ferrous Chloride, Ferrous Sulphate, Sodium Sulphate
Silver	—	Chlorine (pure vapour or liquid)
Stainless Steel 303	Acetaldehyde, Acetic Acid, Acetone, Acetylene, Acrolein, Air, Alcohol, Ammonia, Ammonium, Fluosilicate, Ammonium Hydroxide, Ammonium Nitrate, Ammonium Phosphate, Amyl Acetate, Amyl Chloride, Aniline, Argon, Arochlor, Asphalt, Barium Hydroxide, Barium Sulphide, Beer and Beer Mash, Beet Sugar Liquors, Benzaldehyde, Benzol, Black Sul. Liquor, Blood, Borax, Boric Acid, Boron Trifluoride, Butadiene, Butane, Butylene, Calcium Hydroxide, Camphene, Carbon Bisulphide, Carbon Dioxide, Carbon Monoxide, Carbon Tetrachloride, Carbonic Acid, Chloro Ethane, Chloroform, Citric Acid, Clay Slurries, Coffee, Copper Sulphate, Creosote, Cresols Cresylic Ac., Cyanogen Chloride, Cyanohydrin, Cyclohexane, Cyclohexanone, Cycloproane, Diethylene Glycol, Dioctyl Phthalate, Diphenyl, Dowtherm, Embalming Fluid, Ethane Gas, Ethanolamine, Ether, Ethyl Acetate, Ethyl Acrylate, Ethyl Cellulose, Ethyl Chloride, Ethyl Mercaptan, Ethylene	Phenol

TABLE 51—*continued*

Material	Impervious To	Highly Resistant To
Stainless Steel 303	Chlorohydrin, Ethylene Dichloride, Ethylene Glycol, Ethylene Oxide, Fatty Acid, Fish Oils, Formaldehyde, Freon, Gasoline, Gelatin, Ginger Ale, Glue, Glycerine, Glycol, Helium, Heptane, Hexane, Hydrocyanic Acid, Hydrogen Hydrogen Sulphide, Hydroquinone, Illuminating Gas, Kerosene, Ketones, Lacquers, Lactic Acid, Latex, Lead Nitrate, Lime Slurries, Lithium Chloride, Lubricating Oils, Magnesium Hydroxide, Magnesium Sulphate, Mercaptan, Mercury, Mesityl Oxide, Methyl Chloride, Methyl Methacrylate, Milk, Molasses, Naphtha, Naphthalene, Nickel Sulphate, Nitric Acid, Nitro Benzene, Nitro Ethane, Nitrogen, Nitro Propane, Nitrous Oxide, Octane Iso, Oleic Acid, Oxalic Acid, Oxygen, Ozone, Palmitic Acid, Paraffin, Pectin, Penicillin, Pentane, Perfume, Petrolatum, Phenolic Sulphonate, Phenylamine O-Bl, Phenylthymalonic, Ester, Phosgene, Phthalic Anhydride, Picric Acid, Pine Gum, Potash, Potassium Chloride, Potassium Chlorate, Potassium Cyanide, Potassium Iodide, Potassium Permanganate, Potassium Phosphate, Potato Glucose Sol., Propane, Propylene, Propylene Dichloride, Propylene Glycol, Propylene Oxide, Pyridine, Pyroligneous Acid, Rosin Emulsions, Silicon Tetrachloride, Soap, Sodium Aluminate, Sodium Carbonate, Sodium Cyanide, Sodium Dichromate, Sodium Ethylate, Sodium Glutamate, Sodium Hydroxide (0-20 p.c. and above 50 p.c.), Sodium Oleate, Sodium Peroxide, Sodium Phosphate, Sodium Resinate, Sodium Silicate, Sodium Sulphate, Sodium Sulphide, Sodium Sulphite, Sodium Thiosulphate. Sorbital, Starch, Steam, Stearic Acid, Stoddard Solvent, Styrene, Sugar Liquor, Sulphur (molten), Sulphur Chloride, Sulphur Dioxide, Tannic Acid, Tar, Terpene Monocyclic, Thiamin Solution, Titanium Tetrachloride, Toluene, Tomato Juice, Trichlorethylene, Turbine Oil, Turpentine, Urea, Urine, Vegetable Oils, Vinyl Acetate, Vinyl Chloride, Vitamins, Water, Wax, Whey, Whisky, Wine, Wort, Xylene, Xylenol, Zein, Zinc Sulphate	Phenol
Stainless Steel 316	Acetic Acid (dil.), Acetic Acid Vapour, Acetic Anhydride, Barium Chloride, Chloroacetic Acid Mon., Chlorosulphonic Acid, Ethylene Diamine, Formic Acid, Furfurol, Hydrogen Peroxide, Maleic Acid, Maleic Anhydride, Manganese Sulphate, Phosphoric Acid, Phosphorous (liquid), Pulp (paper), Salt Acid, Sodium Bleach, Sodium Nitrate, Sulphite Liquor, Tartaric Acid.	Cresols Cresylic Ac., Ferric Sulphate, Ferrous Chloride, Sulphuric Acid (0-93 p.c.)
Steel		Acetone, Acetylene, Acrolein, Ammonia, Ammonium Hydroxide, Ammonium Nitrate, Aniline, Argon, Arochlor, Asphalt, Beet Sugar Liquors, Benzol, Black Sul. Liquor, Borax, Boric Acid, Boron Chloride, Butadiene, Butane, Butylene, Calcium Bisulphite, Calcium Hydroxide, Camphene, Carbon Bisulphide, Carbon Dioxide, Carbon Monoxide, Chlorine (pure), Chlorine Dioxide, Chloro Ethane, Chloroform, Clay Slurries, Creosote, Cyanogen Chloride, Cyanohydrin Cyclohexane, Cyclohexanone, Cyclopropane, Diethylene Glycol, Diphenyl, Dowtherm, Ethane Gas, Ethanolamine, Ether, Ethyl Acetate, Ethyl Acrylate, Ethyl Cellulose, Ethyl Chloride, Ethyl Mercaptan, Ethylene Chlorohydrin, Ethylene Glycol, Ethylene Oxide, Freon, Furfurol, Gasoline,

TABLE 51—*continued*

Material	Impervious To	Highly Resistant To
Steel	—	Glue, Glycerine, Heptane, Hydrocyanic Acid, Hydrogen Chloride Gas, Hydrogen Sulphide, Hydroquinone, Illuminating Gas, Latex, Lead Nitrate, Lime Slurries, Lithium Chloride, Magnesium Hydroxide, Magnesium Sulphate, Mercaptan, Mercury, Mesityl Oxide, Mixed Acid (sulphuric and nitric), Molasses, Naphtha, Napthalene, Nitro Benzine, Palmitic Acid, Petrolatum, Phenol, Phenolic Sulphonate, Phenylethylamonic Ester, Phosgene, Phosphorous (liquid), Phthalic Anhydride, Pine Gum, Potassium Chloride, Potassium Chlorate, Potassium Cyanide, Potassium Hydroxide, Potassium Iodide, Potassium Permanganate, Potassium Phosphate, Potassium Sulphate, Propane, Rosin Emulsions, Silicon Tetrachloride, Soap, Sodium Aluminate, Sodium Carbonate, Sodium Cyanide, Sodium Dichromate, Sodium Ethylate, Sodium Glutamate, Sodium Hydroxide (0-20 p.c. and above 50 p.c.), Sodium Nitrate, Sodium Oleate, Sodium Phosphate, Sodium Resinate, Sodium Silicate, Sodium Sulphate, Sodium Sulphide, Steam, Stearic Acid, Stoddard Solvent, Styrene, Sulphur Chloride, Sulphuric Acid (93-98 p.c.), Sulphuric Acid (fuming Oleum), Tar, Terpene Monocyclic, Thionyl Chloride, Tin Tetrachloride, Titanium Tetrachloride, Toluene, Trichlorethylene, Turpentine, Vegetable Oils, Vinyl Chloride, Wax, Xylene, Xylenol, Zein, Zinc Sulphate.
Tantalum	Ammonium Chloride, Aqua Regia, Bromine, Calcium Hypochlorite, Chlorine (water solution), Chloroacetic Acid, Chromic Acid, Ferric Chloride, Ferrous Chloride, Hydrobromic Acid, Maleic Acid, Mercuric Chloride, Mixed Acid, Nitrosyl Chloride, Tin Tetrachloride	—

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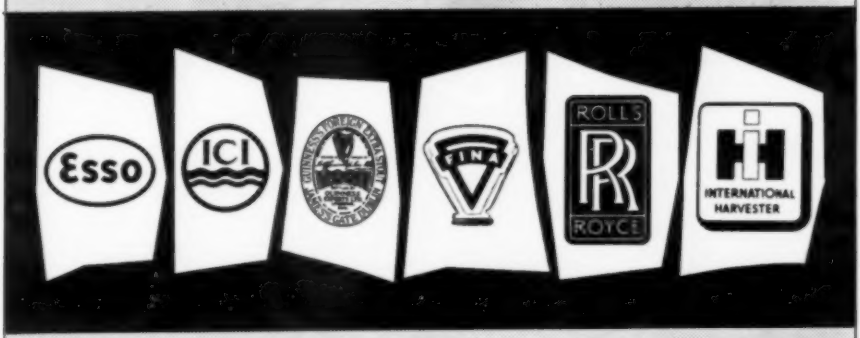

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TABLE 52

COMPARISON OF COMMON ALUMINIUM CASTING ALLOYS

Alloy Classification	Composition-Nominal	Type of Casting	Characteristics and Uses
Aluminium-Silicon	5 p.c. silicon	Sand	Easy to handle in foundry; when molten has high fluidity; used for intricate and/or pressure-tight castings
		Gravity	For general use; cooking utensils made of the more closely controlled compositions because of their corrosion resistance
		Die casting	Resistant to salt water corrosion; used for marine fittings (the alloys of this composition all have excellent corrosion resistance, are not hot short, have low tensile and yield strengths coupled with good ductility; machinability is fair and they do not respond to heat treatment)
	7·5 p.c. silicon plus magnesium	Sand and gravity	Corrosion resistance and castability comparable to those of the 5 p.c. silicon alloys; heat treating improves physical properties over those of the 5 p.c. silicon alloys; machinability is good; these are general purpose alloys
	10 p.c. silicon plus magnesium	Die casting	Often used to replace 12 p.c. silicon alloys as it is easier to die cast
	12 p.c. silicon	Die casting	Used for complicated and/or thin walled castings because of its superior castability; also has excellent resistance to salt water corrosion and freedom from hot shortness
	12 p.c. silicon plus nickel	Gravity	Has low coefficient of thermal expansion, high resistance to wear, good mechanical properties at elevated temperatures; can be heat treated; used for automotive pistons
Aluminium-Copper	4·5 p.c. copper	Sand	Very hot short and can only be sand cast; one of the oldest high-strength, heat treatable alloys; physical properties can be altered by variations in heat treatment; used where combination of high strength, ductility and lightness is needed (such as in parts for internal combustion engines, automobiles and trucks, outboard motors and other marine applications)
	4p.c. copper plus magnesium and nickel	Sand and gravity	Somewhat hot short, used for sand castings and simple permanent mold castings;

TABLE 52—*continued*

Alloy Classification	Composition-Nominal	Type of Casting	Characteristics and Uses
Aluminium-Copper			possesses high physicals and good bearing qualities at elevated temperatures; used for pistons, air-cooled cylinder heads, valve guides, etc.; generally used in heat treated condition; has good machinability
	10 p.c. copper plus silicon and magnesium	Sand and gravity	Has good mechanical properties at high temperatures; has poor castability; responds to heat treatment; used for pistons, cylinder heads, piston sleeves, valve guides, camshaft bearings and other parts requiring high hardness and strength at elevated temperatures
Aluminium-Magnesium	4 p.c. magnesium	Sand	Has very good machinability and highest corrosion resistance of all commercial aluminium alloys; has poor castability and will not respond to heat treatment; used for cooking utensils, food handling equipment, carburettor cases and cast pipe fittings where corrosion resistance, pleasing colour, ability to take a high polish, and average mechanical properties are desired
	4 p.c. magnesium plus silicon	Sand and gravity	Resistant to tarnishing and has better castability than 4 p.c. magnesium alloy; machinability is excellent, does not respond to heat treatment, used for pipe fittings and cooking utensils
	4 p.c. magnesium plus zinc	Gravity	Castability is improved over that of 4 p.c. magnesium alloy; corrosion resistance and machinability are excellent; used as cast
	10 p.c. magnesium	Sand	Combines high strength and elongation with good shock and corrosion resistance; used only in heat treated condition; not used at service temperatures much above 200° F.; special foundry practice needed as its castability is only fair; used for structural parts in aircraft, railway equipment, trucks and buses, etc.
Aluminium-Copper-Silicon	4 p.c. copper, 1·5-2 p.c. silicon	Sand	Combines fair strength and corrosion resistance with good machinability and castability; generally used as cast; a general purpose alloy
		Gravity	Has good corrosion resistance, castability and machinability; responsive to heat treatment; used as a general purpose alloy where high strength and ductility are required

TABLE 52—*continued*

Alloy Classification	Composition-Nominal	Type of Casting	Characteristics and Uses
Aluminium-Copper-Silicon	7·5 p.c. copper, 2·5 p.c. silicon plus zinc	Sand and gravity	Can easily be made from scrap; combines fair corrosion resistance, very good castability and excellent machinability; generally used as cast (sometimes castings are annealed); used for a variety of automotive parts, washing machine agitators, etc.
	7 p.c. copper, 5·5 p.c. silicon plus magnesium and zinc	Gravity	Can be made from scrap; has good castability and machinability; corrosion resistance is fair; generally given a stabilising (or ageing) heat treatment; used largely for automotive pistons
	10 p.c. copper, 4 p.c. silicon plus magnesium and nickel	Gravity	Has fair corrosion resistance, good castability and very good machinability; thermal expansion is low; used for pistons and for flat-iron sole plates
Aluminium-Silicon-Copper	5·5 p.c. silicon, 4·5 p.c. copper plus zinc	Sand and gravity	General purpose alloy having all-round characteristics, heat treatable
	5·5 p.c. silicon, 4·5 p.c. copper	Gravity	A general purpose alloy; has excellent castability, fair corrosion resistance and good machinability; used as cast
	5 p.c. silicon, 3·5 p.c. copper plus zinc	Die casting	A cheap, general purpose alloy suitable for simple castings; corrosion resistance is fair
	8·5 p.c. silicon, 3·5 p.c. copper plus zinc and nickel	Die casting	Castability is improved over that of 5 p.c. silicon, 3·5 p.c. copper plus zinc alloys; can be made from scrap; alloy SC 6 (SAE 306) is used in cold-chamber die-casting machines; alloy SC7 (SAE 308) is suited to use in gooseneck machines
	5 p.c. silicon, 1 p.c. copper plus magnesium	Sand and gravity	Excellent castability, good corrosion resistance and machinability; heat treatable; used for liquid-cooled cylinder heads and other applications where intricate, sound, high-strength (at elevated temperatures) castings are needed
	8 p.c. silicon, 1·5 p.c. copper plus manganese, magnesium, zinc, chromium and nickel	Sand	Has excellent castability, good corrosion resistance and machinability; responsive to heat treatment; used for diesel and gasoline engine parts

TABLE 52—*continued*

Alloy Classification	Composition-Nominal	Type of Casting	Characteristics and Uses
Aluminium-Silicon-Copper	12 p.c. silicon, 1·5 p.c. copper plus manganese, magnesium and zinc	Gravity	Machinability and castability are fair; has good corrosion resistance and is heat treatable; used for pistons
Aluminium-Zinc-Magnesium	8 p.c. zinc plus magnesium and copper, 5·5 p.c. zinc plus magnesium, titanium and chromium, 4 p.c. zinc, 2 p.c. magnesium, plus manganese and chromium	Sand and gravity	This is a relatively new group of alloys possessing high dimensional stability and high physical properties without heat treatment (the 4 p.c. zinc, 2 p.c. magnesium alloy can have its physicals improved by heat treatment); these are premium priced alloys, very sensitive to contamination by silicon; machinability is generally excellent; the 5·5 p.c. zinc alloy remains very ductile (permitting severe cold working) for about two weeks after casting (unless aged artificially)

TABLE 53

TEMPORARY CORROSION PROTECTIVES

Temporary protectives are used to prevent rust or corrosion between various manufacturing stages. Much depends upon the use of the article—for example, with spares ease of removal is most important. Sometimes the coating must be removed before use and sometimes not. In addition according to the conditions of transport the hardness of the protective must be considered and, of course, the importance of wrapping and packaging must not be overlooked.

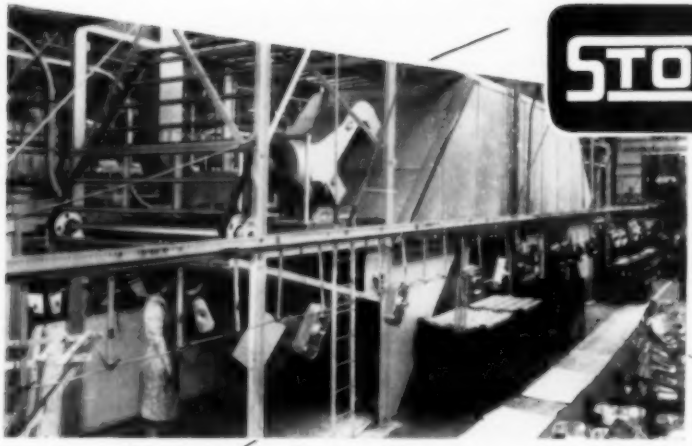
Type	Composition and Specification Number	Notes on the Material	Specific Applications
Hard film types	(*a*) C.S.1033D. A neutralised woolgrease-bitumen mixture dissolved in naphtha or trichlorethylene	Dries to tough black film—slightly tacky—in 30 minutes. Check total solids within 30-40 p.c. Useful for long term storage in tropical conditions. Suitable for machined parts—ferrous and non-ferrous. Not for internal combustion engines or assemblies. Not on natural or synthetic rubber. Suitable for impregnating phosphated parts. Waxed paper suitable for wrapping. Remove by kerosene, white spirit or diesel fuel oil	Camshafts, crankshafts, gears (not assemblies), washers, shackle and gudgeon pins, hand tools, bolts, etc.
	(*b*) D.T.D.279B. A lanolin resin medium, medium pigmented with zinc chromate extended with kaolin and thinned with pool spirit and xylol	Hard and better corrosion resistance than (*a*). Apply by brushing or dipping. Specially developed for light alloy parts	Steel and light alloy sheets and tubes. Joints between dissimilar metals
	(*c*) D.T.D.663. Similar to (*b*) with omission of zinc chromate and kaolin	Usually contains a red dye for easier recognition. Suitable for tropical conditions	Steel and light alloy sheets and tubes. Engine and aircraft spares
Soft Film Types (Thick films)	(*a*) C.S.881F. A lubricating grease consisting of lime, soap and mineral oil	Gives a soft greasy film of any thickness. It has a flow point greater than 100°C. and is usable in the tropics. Applied by brushing or smearing (cannot be melted or dispersed in solvent). Pack in greaseproof paper. Will disperse harmlessly in lubricating oil	Protection of electrical machines, twisted wheels and pulleys, etc., over parts not painted
	(*b*) C.S.2296. Mineral jelly-beeswax	Firm greasy film. Dip at 90°C. or brush. Applicable to partly painted articles and synthetic rubber. Wrap in greaseproof paper. Remove in kerosene or disperse in warm lubricating oil. Suitable for tropical use	Pistons, road springs, ball and roller bearings, timing chains

TABLE 53—*continued*

warm lubricating oil. Suitable for tropical use

TABLE 53—*continued*

Soft Film Types (Thick films)—continued	(*c*) C.S.2298B. A soft grease containing lead stearate in castor oil. Coloured violet for identification	Apply by brush or hot dipping at 100° C. for a short period. Developed for rubber parts in contact with metal. Solvents not used for removal (affect on rubber). Remove grit and dirt only before use	Metal in contact with non-oil-resistant rubbers
Thin films	C.S.1746D. D.T.D.121D. 30-35 p.c. lanolin in coal tar naphtha or white spirit. C.S.1746D. Coloured green for recognition	Greasy but hardens on ageing. Thinner than thick types and not such good protection. Its low M.P. (35-40° C.) makes it unsuitable for tropics. Applicable to phosphated surfaces. Not for rubber or grease-packed ball bearings. Apply by brushing, dipping or spraying. Wrap in greaseproof paper. Remove grit and dirt only before use.	Engine cylinders (not aero), differential assemblies, etc.
Oil Protectives (inferior to solid film types but used where latter cannot be used—internal surfaces, delicate mechanisms)	(*a*) C.S.1663E. A thin lubricating oil containing 10 p.c. lanolin and 5 p.c. kerosene to aid penetration	Liquid at room temperature. Wrap in greaseproof paper. Applicable to rubber and phosphated surfaces. Apply by brushing, dipping or spraying	Internal surfaces, large numbers of nuts and bolts
	(*b*) D.T.D.587. An engine oil diluted to spray consistency with lead free petrol (15 p.c.) 3/4 p.c. corrosion inhibition in oil base	Apply by spraying or dipping	An engine corrosive preventive. Aero engine cylinders, springs, valves
	(*c*) D.T.D.561	A light anti-freezing, corrosion inhibiting oil	Instruments
	(*d*) C.S.906 C.S.1721. Contain 1¼ p.c. triethanolamine and 13¼ p.c. oleic acid	C.S.906 in temperate and tropical climates. Applicable to phosphated surfaces. Not for copper base alloys	Instruments
Water Displacing Fluids (Dewatering oils)	C.S.2060	Displaces water from a metal surface and leaves a protective greasy film. Suitable as protective for wet articles where no drying facilities available and storage before proper protection is undertaken. Apply by dipping or flushing	



STORDY

BATCH OR CONTINUOUS PLANT FOR METAL FINISHING

Batch production or continuous line processing is no problem to the Stordy organisation who have long specialised in the engineering and building of all types of plant for metal pretreatment and finishing. The new Catalogue No. 50 illustrates a wide range of Stordy plant in this field.
Illustration above: A small type "A" stoving oven, town gas fired and fully air circulated for the finish stoving of a large range of sheet metal and small cast components.
Illustration below: Part of an installation of batch loading, steam heated, air circulated ovens used in the production of impregnated brake linings.

STORDY ENGINEERING LIMITED
CUMBRIA HOUSE · GOLDTHORN HILL · WOLVERHAMPTON

SM SE 3053

TECHNICAL DATA

Official Specifications, Conversion Tables, Metal and Alloy Uses, Electro Potentials

OFFICIAL FINISHING SPECIFICATIONS

SOURCES OF SUPPLY

IN presenting the following lists an attempt has been made to bring together information which is relevant to the finishing industry. These lists include revisions and cancellations according to the latest available advices, covering D.T.D. and C.S. specifications.

D.T.D. Specifications

These are issued by H.M. Stationery Office, York House, Kingsway, London. W.C.2. (Against order insert "current issue.")

Paints, Dopes and Ingredients

56D	Stoving Enamel.
96	Thinner for Synthetic Paints (50 per cent. aromatic).
226B	Paint Remover.
234B	Clear Varnish for Internal Protection of Drinking Water Tanks
235B	Low Temperature Stoving Enamel (priming and finishing coat).
314B	Matt Pigmented Oil Varnishes and Primer.
399A	Enamels resistant to hydraulic fluids.
420C	Matt Pigmented Lanolin-Resin Finishes.
426	Ethyl Cellulose.
441	Distemper—Matt Finish.
449	Silicate Paint for Timber.
557A	Flexible Paint.
573	Fluorescent Paint.
591C	Nitrocellulose.
623A	Pigmented Shellac Solution.
751	Aeroplane Doping Scheme of Low Tautness.
752	Aeroplane Doping Scheme of Medium Tautness.
753	Aeroplane Doping Scheme of High Tautness.
754A	Cellulose Finishes and Primer.
766A	Light Weight Finish (Cellulose Base).
772A	High Gloss Finishing Scheme.
785	Cellulose Glossy Black Finish for Aeroplane Doping Schemes.
827	Glossy Synthetic Pigmented Enamels and Primer.
840	Thinner for Synthetic Paints.
843	Thinner for Cellulose Paints and Dopes.
868	Etching Primer.
875A	Clear Baking Varnishes for Heat Exchangers.
892A	Pigmented Baking Varnishes for Heat Exchangers.
899A	Cellulose Finishing Scheme (Ester Lubricant Resistant).

Process Specifications

901C	Processes for cleaning Metal Parts in preparation for Protection against Corrosion.

902D Protection of Metal Parts against Corrosion by means of Organic Protectives.
903C Zinc Plating.
904 Cadmium Plating.
905A Nickel Plating (Heavy).
906A Metallising. (Aluminium and Zinc Spraying.)
907B Aluminising.
908 Sherardizing.
909 Protection of the Interior of Drinking Water Tanks against Corrosion.
910C Anodic Oxidation of Aluminium and Aluminium Alloy Parts.
911B Protection of Magnesium-Rich Alloy Parts against Corrosion.
912B Protection of External Surfaces of Plywood.
913 Identification Colouring of Aluminium and Aluminium Alloy Rivets following M.B.V. Treatment.
915B Process for Cleaning Aluminium and Aluminium Alloy Plating prior to Painting.
916A Hard Chromium Plating of Steel.
917A Method of Varnishing Heat Exchanger Matrices.
919A Electroplating Aluminium, Steel and Copper with Silver and Nickel.
922A Manufacture of Carbon Monoxide Indicator Tubes, Mark III.
923A Chromate Passivation of Zinc Surfaces.
924 Elecrodeposited Tin Coatings.

Organic Corrosion Preventatives and Ingredients

122C Lanolin.
279B Pigmented Lanolin Resin Solution.
369A Pigmented Varnish Jointing Compound.
375D Resin.
495 Calcium Chromate (for corrosion inhibitor cartridges).
663A Lanolin Resin Protective.
791B Engine Cylinder Protective (wax thickened).
804 Lanolised Oil.

Approval of Materials and Processes

900J Approval Procedure for Proprietary Materials and Processes.
925B The Heat Treatment of " Perspex " Panels and Shapings.
926A Process for the External Finishing of Radomes (Amdt. 3).
927A Tin-Zinc Alloy Plating.
5002 ¾ per cent. Nickel-Chromium Case Hardening Steel.
5010 Aluminium-Copper-Magnesium-Silicon-Manganese Alloy Plate (solution treated and aged at room temperature) (Cu. 4·4, Mg. 0·7, Si 0·7, Mn. 0·6).
5012 100-ton 3 per cent. Chromium-Molybdenum-Vanadium Steel (suitable for air hardening) (limiting ruling section 1¼-in.)
5030 Aluminium-coated Aluminium-Copper-Magnesium-Silicon-Manganese Alloy Plate (solution treated and aged at room temperature) (Cu. 4·4, Mg. 0·7, Si 0·7, Mn. 0·6).
5031 Magnesium-Zinc-Zirconium Alloy Bars and Sections (Zinc 5·5, Zirconium 0·7).

C.S. SPECIFICATIONS

These are obtainable from the Ministry of Supply, Chemical Inspectorate, Block A/4, Station Approach Buildings, Kidbrooke, London, S.E.3, and those affecting the finishing industry are as follows:

690B Varnish, exterior.
691B Varnish, interior.

1033E Composition, Rust Preventive.
1053A Gold size, type Q, Lead-free.
1116 Paint P.F.U., acid resisting.
1163 Paint, Textured, Matt Finish.
1317C (i) Mineral Jelly, G.S.
(ii) Mineral Jelly, Lead-free.
1662D Oil, cutting soluble.
1831E Solution, wood preservative.
1840C Paint, Finishing, for Wooden Boxes.
1841A Paint P.F.U., Bronze, Stoving.
1844 Varnish, Copal, Lead-free.
2060C Preservative, P.X.10. (Fluid, water displacing.)
2100 Salts, wood preservative, Tanalith.
2101D Solution, Wood Preservative, special. (Wolmans salts.)
2161E Paint Remover, non-inflammable, G.S.
2184E Varnish, adhesive, nitrocellulose.
2272B Enamel, black, high bake, first coat.
2275A Thinner for Composition Rust Preventive.
2296B Protective PX 11.
2308A Paint P.F.U., eggshell, finishing, air-drying, Telecommunications equipment.
2309A Paint P.F.U. glossy, finishing, air-drying, Telecommunications equipment.
2331 Lanolin Solution.
2332 Composition, Preservative, spraying.
2352A Paint, Finishing, Bituminous for Water Containers.
2398A Paint P.F.U., Bituminous emulsion, for application to canvas.
2401 Paint P.F.U., War equipment, stoving.
2432E Solution, Rust Remover, type A.
2433D Solution, Rust Remover, type B.
2465A Lacquer, clear, Phenol Formaldehyde, stoving, lead-free.
2500C Tape, adhesive, cellulose film.
2501C Tape, adhesive, waterproof, transparent, colourless.
2626F Paint, Pretreatment.
2734 Paint, Enamel, Finishing, for Baths (and Undercoat).
2759B Paint, Finishing, for Respirator Containers, Stoving.
2769 Paint Remover, Water Rinsable.
2985 Grease LG.190, 280, 320.

D.E.F. Specifications

A number of C.S. specifications have now been superseded by DEF (Defence) specifications and those applicable to the finishing industry are listed below. It should be noted that DEF specifications are obtainable from Her Majesty's Stationery Office as the sole source of supply.

1035A Paint, priming, red oxide of iron/zinc chrome—for steelwork—marine and inland.
1036 Paint, priming, red oxide of iron/zinc chrome—as 1035 but stoving.
1037 Paint, priming, red lead—for heavy structural steelwork.
1038 Paint, priming, red and white lead—for wood and metal assemblies.
1039 Paint, priming, zinc chrome—for light alloys and steel—marine and inland.
1041 Paint, finishing—exteriors of jerricans, etc.
1042 (1) Paint, finishing—exteriors of jerricans—as 1041 but stoving.
(2) Paint, concentrated, finishing—exteriors of jerricans—stoving, dipping, flow-coating.

1043	Paint, finishing—interiors of bulk petrol tanks—also application as two-coat system.
1044A	(1) Paint finishing, vehicles, high gloss. (2) Paint finishing, vehicles, high gloss, heat-resisting. (3) Paint, undercoat, vehicles.
1045A	(1), (2) and (3)—as 1044 but stoving.
1048	(1) Paint, finishing—for steel ammunition. (2) Paint, priming—for steel ammunition. (3) Paint, finishing, lead-free—for steel ammunition. (4) Paint, priming, lead-free—for steel ammunition.
1049A	(1), (2), (3) and (4)—as 1048 but stoving.
1050A	(1) Paint, finishing, one-coat—steel ammunition. (2) Paint, finishing, one-coat, lead-free—steel ammunition.
1051	(1) and (2)—as 1050 but stoving.
1052	Paint, finishing, single- or two-coat, general service, glossy.
1053	Testing of paint, varnish, lacquer, etc., under DEF specifications—standard methods.
1059	(1) Paint, finishing, instruments, semi-gloss, stoving. (2) Paint, finishing, instruments, high gloss, stoving. (3) Paint, priming, for paint, finishing, instruments, stoving.
1096	Paint, Finishing, General Service, Gloss, Stoving.
1099	Paint, Aluminium, for Metal.
2331	Temporary Rust Preventive.
1110	(1) Paint War Equip. matt. (2) Paint War Equip. matt, heat resisting.
1111	(1) Paint War Equip. matt, stoving. (2) Paint War Equip. matt, heat-resisting stoving.
1114	Paint, finishing, fire-retardant, white and tinted white.
1115	Paint, priming, zinc chrome, fire retardant.
1116	(1) Paint, finishing, acid and alkali resisting. (2) Paint, priming for use under paint, finishing, acid and alkali resisting.
1117	Paint, non-slip.
1120	(1) Paint, marking. (2) Paint, marking, lead free.
1121	(1) Paint, finishing, acid and alkali resisting, stoving. (2) Paint, priming, for use under paint, finishing, acid and alkali resisting, stoving.
1125	Paint, aluminium, fire-resisting.
1126	Paint, aluminium, fire-resisting, stoving.
1139	Paint, finishing, cellulose nitrate (nitrocellulose) ammunition.
1141	(1) Paint, finishing for the interior of jerricans, stoving. (2) Paint, finishing for the exterior of jerricans, stoving.
1145	Paint system for cellulose finishing of vehicles.
1146	(1) Paint, finishing, for the interior of optical instruments, stoving, matt, black. (2) Paint priming, for use under paint, finishing, for the interior of optical instruments, stoving, light bronze green.
1148	Paint, finishing, general service, heat resisting (200°C.), stoving.
1149	(1) Paint, finishing, general service, heat resisting (130°C.). (2) Paint, finishing, general service, heat resisting (130°C.) lead free.
1161	Paint P.F.U., oil-resisting, air-drying, nitrocellulose.
1162	Paint P.F.U., oil-resisting, stoving, black.

In addition to the above, there are a number of other specifications of interest which are enumerated as follows:

A.S.R.E. Specifications—The Captain Superintendent, Admiralty Signal and Radar Establishment, Lythehill House, Hazelmere, Surrey.

TECHNICAL DATA

D.N.C. Specifications—Naval Construction Dept., Admiralty Office, Warminster Road, Bath, Somerset.

K Specifications—The Chief Inspector of Naval Ordnance, Specification Section, Admiralty, Bath, Somerset.

Schedule 720 (*Specifications and Tables*)— The Captain Superintendent, Admiralty Signal and Radar Establishment, Lythehill House, Hazelmere, Surrey.

Army Vocab.—H.M. Stationery Office, York House, Kingsway, W.C.2.

"E" Specifications (*Ministry of Supply*)—The Chief Inspector of Stores, Central Ordnance Depot, Didcot, Berks.

"E" and "I" Specifications (*Ministry of Supply*)—The Director, Royal Aircraft Establishment, Electrical Engineering Dept., Farnborough, Hants.

"E.L." Specifications (*Ministry of Supply*)—The Director, Royal Aircraft Establishment, Electrical Engineering Dept., Farnborough, Hants.

"G.D.E.S." Specifications—H.M. Stationery Office, York House, Kingsway, W.C.2.

"G.P.O." Specifications—Engineer-in-Chief's Office, Plant Branch, G.P.O., Leith House, Gresham Street, London, E.C.1.

"I.E.E." Publications—Institution of Electrical Engineers, Savoy Place, London, W.C.2.

"I.E.M.E." Specifications—The Chief Inspector, Electrical and Mechanical Equipment, "Aquilla," Golf Road, Bromley, Kent.

Instrument Design Notes (*Ministry of Supply*)—The Director, Royal Aircraft Establishment, I.A.P. Dept., Farnborough, Hants.

"L" Specifications (*Ministry of Supply*)—The Chief Inspector of Armaments, Issue Branch, Rad Barracks, Woolwich, S.E.18.

"R.C.S.C." Specifications—The Secretary, Radio Standards Components Committee, Castlewood House, 77-91 New Oxford Street, London, W.C.1.

"R.G." Specifications—The Director, Royal Aircraft Establishment, Instrument and Photographic Dept., Farnborough, Hants.

"S.R.D.E." Specifications—The Chief Superintendent, S.R.D.E., Somerford, Christchurch, Hants.

Standardisation Design Memoranda (*Air Service*)—S.A.E. Records, Thames House, Millbank, S.W.1.

"T.G." Specifications—H.M. Stationery Office, York House, Kingsway, W.C.2.

"T.S." Specifications—The Chief Chemical Inspectorate, Block A/4, Station Approach Buildings, Kidbrooke, London, S.E.3.

"W.T." Board Specifications (*Ministry of Supply*)—R.C.S.C./R.D.C.6.B., Thames House South, Millbank, S.W.1.

LIST OF BRITISH STANDARDS

AFFECTING THE FINISHING INDUSTRY

Obtainable from the British Standards Institution, 2 Park Street, London, W.1

AS NZ SA signify that the standard has been endorsed by the Dominion Standards Authority for use as an Australian, New Zealand or South African standard respectively

B.S.

10 : —— **Tables of pipe flanges (for land use).**

These tables are issued in five parts as follows:

10: Part 1: 1947 **Pipe flanges for land use (for pressures up to 400 ft. head)** 12pp. 3s. Amendment PD 1157, March, 1951. AS

10: Part 2: 1926. **For working steam pressures up to 450 lb./sq. in. (tables D to P).**
16pp. 3s. 6d. Amendment CC(ME) 6311, June, 1927. AS NZ

10: Part 3: 1929 **For working steam pressures above 450 lb./sq. in. and up to 600 lb./sq. in. (table R).** AS NZ
16pp. 3s. 6d. Amendment CC 3901, April, 1931.

10: Part 4: 1931 **For working steam pressures above 600 lb./sq. in. and up to 900 lb./sq. in. and temperatures to 800° F. (427° C.) (table S).** SA
16pp. 3s. 6d.

10: Part 5: 1932 **For working steam pressures above 900 lb./sq. in. and up to 1400 lb./sq. in. and temperatures up to 800° F. (427° C.) (table T.).** SA
16pp. 4s.

In each case tables of dimension for various nominal pipe sizes are given with metrical equivalents and illustrative drawings, together with bolt circle and bolt sizes. Flanges may be of cast iron, bronze, cast steel, or forged iron or steel, where appropriate. For Parts 4 and 5, tensile and notched bar tests are required and the test specimens to be used are illustrated.

18 : 1956 **Tensile testing of metals.**
24pp. 4s. 6d.

Section 1 contains definitions of the principal terms; the limit of proportionality, yield, proof and ultimate tensile stress, percentage elongation and percentage reduction of area and Young's modulus.
Section 2 describes the forms of test pieces for sheets, plates, strips, flat bars and sections; machined test pieces for general purposes; special tensile test pieces for cast iron and malleable cast iron, for wire, for tubes and for steel cylinders. Standard methods of procedure are specified in Section 3.

89 : 1954 **Electrical Indicating Instruments.**
52pp. 8s. 6d.

General considerations affecting the design and construction of substandard and first-grade instruments are dealt with, and the permissible limits of error are set out. Requirements for external shunts, and for the marking of the scales are stated. Notes on the accuracy of different types of instrument, methods to be used in testing instruments, and terminal markings are included.

90 : 1940 **Graphic (recording or chart-recording) ammeters, voltmeters, wattmeters, power-factor meters and frequency meters.** NZ
28pp. 6s.

General considerations affecting design and construction are dealt with and chart-speeds are standardised. Limits of error are specified and provision is made for voltmeters of special accuracy. Variations in indication due to various influences are dealt with and notes on the accuracy of different types of instrument, on charts and driving mechanisms and terminal workings are included.

B.S.

97 : 1958 **Watertight electric light fittings.**
4s. 6d.
This specification covers bulkhead and well-glass types of fittings, giving details of construction and dimensions of the parts, with a view to securing interchangeability.

115 : 1954 **Metallic resistance materials for electric purposes.**
14pp. 4s. 6d.
This specification covers five classes of resistance materials viz:
A. Lower temperature coefficient at temperature not exceeding 60° C.
B. Higher temperature coefficient at temperature not exceeding 200° C.
C. Temperature coefficient varying over wider range at temperatures up to 350° C.
D. For high temperatures not exceeding 850° C.
E. For high temperatures not exceeding 1050° C.
Wires, sheets, strips and tapes are included, tolerances on resistivity and sizes are listed and a table of standard wire sizes is included.

125 : 1954 **Hard-drawn copper conductors for overhead power tranmission purposes.**
20pp. 4s. 6d. Amendment PD 2515, August, 1956.
Standard values of the physical constants of hard-drawn copper are stated. Data on standard resistances, weights and sizes, and mechanical properties are given, for both solid wires and stranded conductors. Tolerances and standard lay ratios are prescribed, and requirements are given for joints and for testing. The appendix gives the international standards of resistance for copper.

138 : 1948 **Portable fire extinguishers of the water type (soda acid).**
24pp. 6s. Amendments PD 1366, April, 1952; PD 2459, May, 1956.
The class of extinguisher to which this standard applies is that in which the pressure required to expel the liquid contents is generated by the chemical action of an acid in conjunction with a carbonate or bicarbonate solution.
The standard gives requirements for the materials used, the type and dimensions of the various parts, and the details of riveted, lock-joint and welded construction. Tests and markings are also covered.

144 : 1954 **Coal tar creosote for the preservation of timber.**
20pp. 3s. 6d.
Includes specifications for three types of coal tar creosote. The specifications cover specific gravity, fluidity, distillation range and include limits for water content, residue after distillation, tar acids and matter insoluble in benzole. Sampling and test methods are described.

156 : 1951 **Enamelled round copper wire (oleo-resinous enamel).** NZ
24pp. 4s. Amendments PD 1325, December, 1951; PD 2155, April, 1955; PD 2580, September, 1956.
Covers the requirements of oil-base-enamel wire used for winding coils for electrical machinery and apparatus, and does not cover wires insulated with other than oleo-resinous enamels. It includes two classes of wire, differing only in the thickness of the insulation, one class being designated "normal covering" and the other "thick covering." All sizes of wire from 0.001 in. to 0.160 in. dia. are included. It gives details of diameters, resistances, and thickness of enamel (including tolerances), together with tests on the enamel insulation. These tests include hardness, flexibility and adherence, heat shock, cold test at 0° C., heat ageing and electric strength. The standard sizes of wires complying with this specification are given in S.W.G. and in an appendix are given details of a range of wires complying with Brown and Sharpe gauges, and provided that wires to these gauges comply in all other respects with the requirements of this standard, they may be deemed to comply with this British Standard.

158 : 1938 **Marking and arrangement for switchgear bus-bars, main connections and auxiliary wiring.** NZ
25pp. 7s. Amendment PD 873, January, 1949.
This specification gives the standard colours for use with A.C. and D.C. systems. A number of drawings and diagrams are included illustrating typical connections. Many of the diagrams are reproduced in

B.S.

colour in order to give a clearer idea of the many colour combinations used for markings.
Connections of generators to bus-bars (phase sequence and polarity) are also shown.

159 : 1932 Bus-bar and bus-bar connections in air, oil or compound. AS NZ
20pp. 2s. 6d. Amendments CE 60, May, 1936; CE 6738, March, 1938; PD 73, January, 1943. Temporarily out of print.
This specifies the quality of the material (copper and aluminium), dimensions of flat, round and tubular bars, limits of temperature, mechanical strength, and clearance distances.
Other matters dealt with include service conditions, thermal losses in bus-bars and connections, calculation of mechanical forces due to heavy currents, and the current rating of bus-bars.

163 : Part 1 : 1943 Galvanized steel wire strand for signalling purposes.
12pp. 3s. Amendments PD 431, December, 1945; PD 700, October, 1947.
Deals with seven wire strand for railway signals in three tensiles with *maximum* elongation on the wire which is required to withstand reversed bending tests. Centre wire in strand is oversize to ensure equally distributed load, increased flexibility and lessened tendency to kink. There is a cautionary foreword as to care in handling and installation to prevent premature failure in service.

163 : Part 2 : 1945 Galvanized solid steel wire for signalling purposes.
10pp. 2s. 6d.
Deals with 10 s.w.g. solid steel wire for railway signals in four tensiles with tests on the wire as in Part 1.

182 to 184 : 1938 Galvanized iron and steel wire for telegraph and telephone purposes.
23pp. 3s. 6d. Amendment CF 8400, September, 1941. See B.S.16.
182. Galvanized iron and steel line wire.
183. Galvanized steel stay wire and suspension strand.
Amendment September, 1941. PD 818, August, 1948.
184. Galvanized steel binding and jointing wire.
Quality of material and dimensions are specified and electrical resistance) and mechanical test requirements are stated and the testing methods described. (For galvanizing test see B.S. 443.) The physical properties (with tolerances) are given, and coiling and packing is described.

186 : 1949 Cast-iron and enamelled cast-iron steam-jacketed pans for the chemical and allied industries. NZ
10pp. 2s. 6d.
Gives full dimensions and material specification for shallow and deep steam-jacketed pans. Three sizes—25, 50 and 100 gallons, are provided for in the shallow type and four sizes—10, 25, 50 and 100 gallons, in the deep type. The pans are designed for a working pressure of 40 lb./sq. in.

217 : 1952 Red lead for paints and jointing compounds. NZ
12pp. 2s. 6d.
Covers three types of material, i.e., Type A—Red lead, ordinary, for paint purposes, Type B—Red lead for jointing purposes, Type C—Red lead (non-setting). Clauses include description of material, composition, non-setting properties (Type C only), residue on sieve, oil absorption value, colour, matter volatile at 98-102° C., matter soluble in water. Sampling and methods of test are described in the Appendices.

220, 221, 222 : 1947 Zinc (fine, special and foundry). NZ
10pp. 2s. 6d.
Covers the chemical composition of the above-mentioned grade of zinc together with methods of sampling for analysis.

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232 : 1952 **Vitreous-enamelled steel reflectors for use with tungsten filament lamps.**
8pp. 2s. Amendment PD 1709, October, 1953.

Covers nine sizes of vitreous-enamelled steel reflectors, commonly known as the "open-dispersive type," and includes requirements regarding material, dimensions, luminous output, distribution of light (Class (A) III, see B.S. 398), angle of cut-off, heating effects and selection of reflectors for testing.

239 : 1952 **White pigments for paints.**
28pp. 5s.

Including:

239. Genuine white lead. NZ*
254. Zinc oxide (types 1 and 2). NZ
296. Lithopone. NZ*
338. Antimony oxide. NZ
637. Basic sulphate of lead. NZ
1481. Leaded zinc oxide. NZ
1851. Titanium dioxide pigments.

Covers in each standard the description of material, composition, residue on sieve, oil absorption value, colour, reducing power, matter volatile at 98° C. to 102° C., and matter soluble in water. Sampling and methods of test are described in the Appendices.

242 : 1936 **Linseed oil for paints.** NZ SA
19pp. 4s. War emergency note. Amendment PD 1117, January, 1951.

Including:

242. Refined linseed oil. Amendment PD 2650, November, 1956.
243. Raw linseed oil. Amendment PD 1377, April, 1952.
259. Boiled linseed oil.

For each of the materials various physical requirements are specified such as colour, iodine value, saponification value, acidity, drying time, etc. Methods of making the various determinations are given in appendices.

244. : 1936 **Turpentine (types 1 and 2) and white spirit.** NZ
15pp. 2s.

Including:

244. Turpentine, type 1.
Amendments CE 1776, November, 1936; PD 956, September, 1949.
245. White spirit.
Amendments PD 474, March, 1946; PD 956, September, 1949.
290. Turpentine, type 2.
Amendment PD 956, September, 1944.

Requirements for specific gravity, quality and various physical properties for the three materials are stated and methods of sampling, distillation, carrying out polymerisation tests, and volatility tests are given in the appendices.

255 : 1938 **Extenders for paints. (Superseded by B.S. 1795.)**

256 : 1936 **Varnishes.** SA
27pp. 3s. 6d.

Including:

256. Interior oil varnish.
257. Exterior oil varnish.
258. Flatting or rubbing oil varnish.
274. Extra hard drying varnish.

The quality and colour of each type of the material is specified and drying time, volatile content, viscosity, flexibility and adhesion (for 256 and 257), flatting properties (for 258) and hardness (for 274) are stated. Test methods are given in the appendices.

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272 : 1952 **Red oxides of iron or paints.**
20pp. 3s. 6d.
Including:
272. Natural red oxides of iron for paints.
305. Manufactured red oxides of iron for paints, excluding Venetian red.
370. Venetian red for paints.
Covers in each case a description of the material, composition, residue on sieve, oil absorption value, colour, tone and staining power, matter volatile at 98-120° C., together with descriptions of sampling procedure and methods of test. In addition, limits of the contents of carbonates and sulphates are specified in B.S. 305.

282 & 389 : 1953 **Lead chromes and zinc chromes for paints.** NZ
24pp. 4s.
Including:
282. Lead chromes.
389. Zinc chromes. (Types 1, 2 and 3).
These specifications cover: description and composition of the material; contents of coarse particles ; oil absorption; colour, stability of colour (lead chromes).

283 : 1953 **Prussian blue for paints.** (Types 1 and 2). NZ
16pp. 2s. 6d.
This specification describes the material and its composition and includes requirements for such properties as coarse particles, oil absorption comparison of colour and of staining power. Methods are included for the determination of basic iron, iron cyanogen complex and the other properties specified.

284 : 1952 **Black (carbon) pigments for paints.** NZ
16pp. 2s.
Including:
284. Carbon black for paints.
285. Bone black for paints.
286. Lamp (or vegetable) black for paints.
Covers in each standard the description for material, residue on sieve, oil absorption value, colour, tone and staining power, loss in weight at 100-105° C., ash, ether extract, and matter soluble in water. Sampling and methods of test are described in the appendices.

303 : 1953 **Brunswick or lead chrome greens (pure and reduced) for paints.**
16pp. 2s. 6d.
A pure and reduced quality of Brunswick or chrome green are covered. The requirements in both specifications include description of the pigment, its chemical composition, colour, staining power and oil absorption and limits for the amount of coarse particles, volatile matter and matter soluble in water.

306 : 1952 **Black and purple oxides of iron for paints.** NZ
16pp. 3s.
Including:
306. Black oxide of iron.
339. Purple oxides of iron.
Covers in each case a description of the material, composition, residue on sieve, oil absorption value, colour, tone and staining power, matter volatile at 98-102° C., matter soluble in water, together with a description of the sampling and methods of test. In addition, a limit for sulphur and sulphur compounds other than insoluble sulphates is specified in B.S. 339.

311 : 1936 **Gold size for paints.** NZ
12pp. 2s. 6d.
The quality is specified and drying time, volatile content, viscosity, behaviour with white lead paste, keeping qualities and sampling are stated. Methods of determining the properties are described in appendices.

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312 : 1952 **Sienna, umber and ochre for paints.**
16pp. 3s.
Including:
312. Natural sienna (raw and burnt).
313. Natural umber (raw and burnt).
337. Ochre.
Covers in each case a description of the material, composition, residue on sieve, oil absorption value, colour, tone and staining power, loss on drying *in vacuo*, matter soluble in water, together with descriptions of sampling procedure and the methods of test.

314 : 1952 **Ultramarine blue and violet for paints.** NZ
12pp. 2s. 6d.
Includes a description of the material and requirements for residue on sieve, oil absorption value, colour, tone and staining power, matter volatile at 98-102° C. and matter soluble in water. The method of sampling and methods of test are given in the appendices.

318 : 1952 **Green oxide of chromium for paints.**
12pp. 2s.
Specifies composition, residue on sieve, oil absorption value, colour, tone and staining power, matter volatile at 98-102° C., and matter soluble in water. The methods of sampling and methods of test are given in the appendices.

320 : 1938 **Vermillion and red pigment for paints.**
18pp. 2s. 6d.
Including:
320. Vermillion for paints. (Obsolete.)
333. Red pigment (red lakes, toner or pigment dyestuff).
Amendment PD29, August, 1942. Temporarily out of print.
The material is described, and its composition specified, together with requirements for freedom from coarse particles, oil absorption, colour, staining power, ash (for vermillion), volatile matter, matter soluble in water, and "bleeding" test and stability of colour (for red pigment). Sampling technique and the methods of carrying out the various tests are given in appendices.

332 : 1938 **Driers for paints.** NZ SA
332. Liquid driers.
The specification for paste driers covers consistency and composition, colour, skin and coarse particles, water and oil content, keeping properties and sampling. In the case of liquid driers, volatile content, colour, flash point, dilution, mixing and drying properties, keeping properties and sampling are specified. The methods of testing these properties are described.

334 : 1934 **Chemical lead (types A and B).**
23pp. 5s. Memorandum CG 349, May, 1942.
For Type A the chemical composition is detailed and methods of analysis described, in the case of type B the composition shall be agreed between manufacturer and purchaser. A flash test is prescribed in both cases, and an aqua regia test for type A is described in detail. Full details of carrying out the tests and making a chemical analysis are given in appendices.

349 : 1932 **Identification colours for gas cylinders.** NZ
6pp. 2s. Amendments CE 7034, March, 1938, incorporating previous addendum: CF 9295, January, 1942; PD 578, January, 1947; PD 1397, June, 1952.
This specification covers a colour code for identifying upwards of twenty different gases. Table 1 dealing with commercially used gases and table 2 with those for medical purposes.

349C : 1949 **Chart for identification colours for gas cylinders.**
12¼ in. x 21 in. 10s. 6d. mounted, 6s. 6d. unmounted. Amendment PD 1395, June, 1952; PD 2258, June, 1955 (superseding PD 1395).

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Includes the amendments made to B.S. 349, "Identification colours for gas cylinders," and also gives the colours for the cylinders dealt with in B.S. 1319, "Code of practice relating to medical gas cylinders and associated anaesthetic apparatus."

370 : 1938 **Venetian red for paints. (Included in B.S. 272.)**

381 : 1930 **Schedule of colours for ready-mixed paints (see B.S. 381C).**

381C : 1948 **Colours for ready-mixed paints.**
6s. Amendments PD 880, March, 1949; PD 881, May, 1949; PD 955, September, 1949.

This is a colour card illustrating ninety-seven standard colours of ready mixed paints for general purposes and for building decoration. The specimens are approximately 1¼ in. x ⅝ in.
Individual colour specimens (5 in. by 2½ in.) on cards (5 in. by 8 in.), price 1s. 6d. each, or sets of the complete 97 colours in a carton, £5.

PD 1340 : 1952 Supplement No. 1 to B.S. 381C. Colorimetric measurements.
4pp. 1s.

Given measurements of the colours in B.S. 381C in terms of chromaticity (*x*, *y*) and luminance factor (B1) with reference to C.I.E. Illuminant B, and also gives measurements of the total light reflected (B2), for the convenience of architects, illuminating engineers.

PD 1341 : 1952 Supplement No. 2 to B.S. 381C. Chromaticity and luminance factors of colours for ready mixed paints, under C.I.E. Illuminants A, B and C.
4 sheets. 13 in. x 16 in. 3s

388 : 1952 **Leafing aluminium flake (powder and paste) for paints.** NZ
16pp. 2s. 6d.

Specifies requirements for leafing aluminium powder and leafing aluminium paste including composition, grease content, colour, opacity, finish and brightness, residue on sieve, volatile matter (powder only), leafing properties, water covering capacity and water content (paste only). The sampling procedure and methods of test are given in the appendices.

390 : 1953 **Oil pastes for paints.** NZ
12pp. 2s. 6d.
This specification applies to tinted oil pastes (i.e. excluding white pastes) prepared from any single pigment or from a mixture of pigments. Details of composition, colour, condition, oil content, etc., are prescribed and appendices contain particulars of methods to be used in sampling and testing.

391 : 1949 **Tung oil.**
20pp. 4s. Amendment PD 2329, October, 1955.

This British Standard applies to oil derived from species *Aleurites Fordii* (Type F) and *Aleurites Montana* (Type M). The quality of the material is specified by setting limits for volatile matter, colour, specific gravity, refractive index, iodine value, saponification value, acidity, unsaponifiable matter, gelation time and insoluble bromide content. The methods of sampling and testing are described.

399 : 1930 2/6 Add June 1937, May 1938, March 1942, and February 1954: High carbon steel cylinders for the storage and transport of 'permanent' gases.

405 : 1945 **Expanded metal (steel) for general purposes.** NZ
12pp. 3s.

This specification prescribes that the blank steel plates from which the expanded metal is made shall have an ultimate tensile stress of 26/32

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tons per sq. in. for material $\frac{1}{8}$ in. thick and over, and 20/28 tons per sq. in. for material under $\frac{1}{8}$ in. thick. Tables giving the nominal weight per sq. yd., sectional area of strands and maximum sizes of sheets and rolls are given in the specification. A cold bend test and clauses giving permitted tolerances on weights and sizes are included.

417 : 1951 **Galvanized mild steel cisterns, tanks and cylinders.**
18pp. 3s. Amendment PD 1438, July, 1952; PD 1889, June, 1954; PD 2313, September, 1955. (Addendum No. 1: PD 2357, December, 1955, sold separately 1s. 6d.)

Provides for cisterns, tanks and cylinders mainly intended for domestic purposes in ranges of twenty-one sizes of cisterns up to 1,000 gal. nominal capacity, eight sizes of tanks from 17-53 gal. actual net capacity and eleven sizes of cylinders from 16-97 gal. actual net capacity. Clauses cover sizes and gradings, material, manufacture, staying, screwed connections and holes, testing and marking and optional provision for fitting of an immersion heater. Tables of sizes and dimensions are given together with three gradings according to the test pressures and working heads, and appendices contain recommendations for the position of holes in cisterns and tanks, when these are required.

419 : 1931 **Varnished cloth sheet, strip or tape for electrical purposes.**
28pp. 5s.

443 : 1939 **Testing of zinc coating on galvanized wires.** NZ
13pp. 2s. 6d. Amendments PD 340, February, 1945; PD 1681, June, 1953.

The preparation of samples is described and details of the solution used for stripping by immersion are given. The copper-sulphate dipping test is specified and test requirements are stated. Tables of minimum weight of spelter coat and of dipping-test data are given.

470 : 1932 2s. Add. July, 1933. **Manhole openings for chemical plant—fixed and mobile. Size and position only.**
(Not applicable for pressures over 175 lb. per sq. in.)

476 : 1953 **Fire tests on building material and structures.** NZ
26pp. 4s.

The definitions of these terms used in relation to building materials are given, and the methods of testing materials and various parts of structures to determine these characteristics are described.

479 : 1953 **Coal-tar naphthas.**
36pp. 6s.

These specifications cover, colour, specific gravity and distillation range and include limits for water, corrosive sulphur (96/160s), hydrogen sulphide and mercaptans (96/160s and 90/160s), residue on evaporation (96/160s and 90/160s), flashpoint (90/190s and 90/200s) and phenols (90/190s and 90/200s). Neutrality and acid-wash tests are included in the 96/160s and the 90/160s specifications. Sampling and test methods are described.

506 : 1950 **Methyl alcohol.** NZ*
14pp. 2s. Amendments PD 1215, June, 1951; P.D. 1994, October, 1954.

The specification covers specific gravity, miscibility with water, and distillation range and includes limits for acidity, residue on evaporation, aldehydes and ketones and sulphur and sulphur compounds. Sampling and test methods are described.

507 : 1950 **Ethyl alcohol.**
10pp. 2s. Amendment PD 1201, June, 1951.

The specification covers strength and miscibility with water and includes limits for acidity, residue on evaporation and aldehyde content. Sampling and test methods are described and an appendix gives a table showing the relation between specific gravity, proof strength, and percentage of alcohol by volume and by weight.

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508 : 1950 **Normal butyl alcohol (butanol).**
10pp. 2s. Amendments PD 1216, June, 1951; PD 1420, June, 1952.
Covers specific gravity, distillation range and flashpoint; and includes limits for residue on evaporation, acidity and aldehyde content. Sampling and test methods are described.

509 : 1950 **Acetone.** SA
10pp. 2s. Amendments PD 1217, August, 1951; PD 1321, December, 1951; PD 1996, October, 1954.
The specification covers specific gravity, distillation range and miscibility with water, and includes limits for residue on evaporation, acidity, water, alkalinity and alcoholic impurities together with a permanganate test. Sampling and test methods are described.

515 : 1938 **Carbolic acids 60's.** NZ
27pp. 4s.
Includes specifications for crude, dehydrated and distilled acids. The specifications provide for specific gravity, crystallising point and residue on distillation and include limits for water, neutral oils and pyridine bases, acidity and alkalinity. Methods of sampling and analysis are specified.

517 : 1955 **Cresylic acid of specified orthocresol content.**
28pp. 5s.
Provides for specific gravity, distillation and minimum orthocresol content and includes limits for water, residue of distillation, neutral oils and pyridine bases, hydrogen sulphide and freedom from acids and alkalis. Methods of sampling and analysis are specified.

521 : 1955 **Cresylic acid of specified metacresol content.**
28pp. 5s.
This British Standard provides for five grades of cresylic acid, with varying metacresol contents, and covers metacresol content, specific gravity and distillation range and includes limits for water, neutral oils and pyridine bases, hydrogen sulphide and acids and alkalis. Sampling and test methods are described.

522 : 1955 **Orthocresol, metacresol and paracresol.**
20pp. 3s.
This British Standard covers solubility of the materials in caustic soda, their specific gravity, boiling point and crystallising point, and includes limits for residue on evaporation. Sampling and test methods are described.

523 : 1955 **Phenol.**
16pp. 3s.
This British Standard covers solubility of the material in water, its crystallising point and boiling point and includes limits for residue on evaporation and water content. Sampling and test methods are described.

524 : 1955 **Refined cresylic acid.**
24pp. 4s.
This British Standard provides for six grades of material, i.e., 99·5, 99, 98, 97 and 95 per cent. respectively, and covers specific gravity, colour and distillation range. Limits are specified for residue or distillation water content, pyridine bases and neutral oils, acids, and alkalis and hydrogen sulphide. Sampling test methods are described.

544 : 1934 **Linseed oil putty (types 1 and 2).**
8pp. 2s. 6d. Amendments CF 1339, February, 1939; CF 7030, December, 1940.
The two types covered by this specification are: Type 1, linseed oil for use in wooden frames; type 2, gold size putty for use in metal frames. The material is described and requirements are given in respect of: skins and coarse particles; water content; keeping qualities; and sampling technique. Appendices give the methods of test, and a table of dimensions of B.S. test sieves. (Type 2 has subsequently been cancelled.)

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549 : 1950 **Diacetone alcohol.** NZ*
8pp. 2s. Amendments PD 1202, June, 1951; PD 1997, October, 1954.
The specification covers specific gravity, distillation range, flash point, and miscibility with water and includes limits for water content and acidity. Sampling and test methods are described.

551 : 1950 **Normal butyl acetate.**
12pp. 3s.
The specification covers specific gravity and distillation range and includes limits for residue on evaporation, acidity and ester content. Sampling and test methods are described.

552 : 1950 **Amyl acetate.**
8pp. 2s. Amendments PD 1204, June, 1951; PD 1999, October, 1954.
The specification covers specific gravity and distillation range and includes limits for residue on evaporation, water, acidity and ester content. Sampling and test methods are described.

553 : 1950 **Ethyl acetate.**
12pp. 3s.
The specification covers specific gravity and distillation and includes limits for residue on evaporation, water, acidity and ester content. Sampling and test methods are described.

558 : 1953 **Nickel anodes and nickel salts for electroplating.**
28pp. 4s.
Specifies composition and limits of impurities and includes methods of analysis. The salts covered are nickel ammonium sulphate, nickel sulphate and nickel chloride.

564 : 1934 Included in B.S. 558.

573 : 1950 **Dibutyl phthalate.** NZ*
7pp. 2s. Amendments PD 1206, June, 1951; PD 1299, November, 1951.
The specification covers specific gravity and refractive index and includes limits for water, ash, acidity and ester content. Sampling and test methods are described.

574 : 1950 **Diethyl phthalate.**
7pp. 2s. Amendments PD 1207, June, 1951; PD 1497, October, 1952.
The specification covers specific gravity and refractive index and includes limits for water, ash, acidity and ester content. Sampling and test methods are described.

575 : 1950 **Carbon tetrachloride.** NZ*
9pp. 2s. Amendments PD 1208, June, 1951; PD 2001, October, 1954.
The specification covers specific gravity and distillation range and includes limits for residue on evaporation, acidity, oxidisable impurities, free chlorine and sulphur compounds. Sampling and test methods are described.

576 : 1950 **Acetic acid.** NZ*
21pp. 2s. 6d. Amendment PD 1209, June, 1951.
Combines B.S. 576, "Glacial acetic acid and dilute acid." and B.S. 578 "Technical acetic acid," under a single cover with only one set of appendices.
Four specifications are provided: 1. Glacial acetic acid, 99-100 per cent.; 2. Dilute acetic acids, 80, 60 and 40 per cent.; 3. Technical glacial acetic acid, 98-100 per cent.; 4. Dilute technical acetic acids, 80, 60 and 40 per cent. Each covers acetic acid content (related, in the case of glacial acetic acid, to crystallising point) and includes limits for residue on evaporation, iron (not for the chemical acids), chlorides, sulphate, heavy metals, formic acid and acetaldehyde. Test methods are described.

579 : 1951 **Technical ether.** NZ
12pp. 2s. Amendments PD 1421, June, 1952; PD 1989, October, 1954.
This specification covers specific gravity and distillation range and includes limits for residue on evaporation, acidity, peroxides and sulphur compounds. Samplings and test methods are described.

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580 : 1950 **Trichlorethylene (Types A, B and C).**
14pp. 2s. 6d. Amendments PD 1210, June, 1951; PD 2002, October, 1954.

Three specifications are provided: Type A (Technical); Type B (Extraction purposes); Type C (Metal degreasing, dry cleaning and similar purposes). Each covers specific gravity and distillation range, and includes limits for residue on evaporation, alkalinity, free chlorine and (for Type C only) stability. Sampling and test methods are described.

584 : 1935 **Grading for plywood (veneered with oak, mahogany, walnut, teak, and other ornamental woods).**
6pp. 2s. Temporarily out of print.

Various defects and terms used in describing plywood are defined and standard sizes and thicknesses, with tolerances specified. Four grades of plywood are covered.

602, 1085 : 1949 **Lead pipes (for other than chemical purposes).** NZ
30pp. 6s.

Covers pipes from ¼ in. to 6 in. internal diameter. The chemical composition, wall thickness and minimum weight per linear yard for various sizes and for particular applications are dealt with. A turnpin test and marking are specified and the gran size for service and distributing pipes. Details of a method of etching lead pipes are given.

608 : 1943 **Dimensions and testing of metal-sheathed or braided varnished cambric insulated annealed copper conductors for electricity supply.**
28pp. 3s. Amendments PD 120, June, 1943; PD 333, February, 1945; PD 516, June, 1946.

This specification covers cables of the following voltages: 660, 3,300, 6,600 and 11,000 v., but does not deal with the composition, quality or durability of the insulating material. Standards for the physical properties of copper are given, followed by the standard sizes of stranded conductors, tolerances of standard resistance, and variation of resistance with temperature. Thickness of insulation and of metal sheath is specified, as well as the requirements for bedding, armouring, serving and braiding.

622 : 1953 **Cyanides for electroplating.**
12pp. 2s. 6d.

Covers five specifications as follows:
Potassium cyanides, single salt, 96/99 per cent.
Potassium cyanides, single salt (grey) 91/92 per cent.
Sodium cyanides, single salt, KCN value 128/130 per cent.
Cyanides, double salt (sodium and potassium) KCN value, 98/100 per cent.
Sodium cyanides, KCN value, 98/100 per cent.
Each specification covers chemical composition and impurities, sampling and test methods are described.

623 : 1940 **Colours for signal glasses for railway purposes.** NZ
12pp. 2s. 6d.

This covers colorimetric and photometric requirements for all railway signal glasses and limits for colour quality are included and illustrated by a curve. Methods of tests are described.

628-32 & 650-56 : 1950. **Vegetable oils.**
50pp. 7s. 6d.

In one volume, specifying properties of the oils, sampling, and methods for the determination, where required, of: volatile matter, colour, water, refractive index, iodine value, saponification value, acidity, unsaponifiable matter, solution in alcohol, acetyl value and drying time; and for the presence of arachis, sesame and cottonseed oil and stearin.

Comprising:
628 : 1950 Crude coconut oil.
629 : 1950 Crude ground nut oil (arachis oil).
630 : 1950 Edible olive oil.
631 : 1950 Crude rape seed oil.
632 : 1950 Raw linseed oil.

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Amendment PD 1378, April, 1952.
650 : 1950 Castor oil (" firsts " quality).
651 : 1950 Crude maize oil.
652 : 1950 Crude palm kernel oil.
653 : 1950 Crude soya bean oil.
654 : 1950 Perilla oil.
655 : 1950 Refined cottonseed oil. AS
Amendments PD 1319, December, 1951; PD 2089, January, 1955.
656 : 1950 Crude sesame oil.

634 : 1935 **Finishing air-drying insulating varnish for electrical purposes.** AS

13pp. 3s.

The specification covers two types of air-drying moisture-resisting finishing varnish suitable for coils, armatures and the like, viz. varnish with methylated spirit solvent, and varnish with non-alcoholic solvent. Requirements are stated in respect of finish, volatile matter, specific gravity, viscosity, drying time, electric strength in damp atmosphere at 20° C., ageing, and flash point. The methods of test are given in the appendices.

662 : 1950 **Carbon disulphide.** NZ

13pp. 2s. Amendment PD 2003, October, 1954.

The specification covers specific gravity and distillation range, and includes limits for residue on evaporation, acidity and hydrogen sulphide or sulphur dioxide. Sampling and test methods are described.

663 : 1950 **Ethyl lactate.** NZ*

9pp. 2s. Amendments PD 1211, June, 1951; PD 2004, October, 1954.

Covers specific gravity, distillation range and miscibility with water, and includes limits for residue on evaporation, water, acidity and ester content. Sampling and test methods are described.

668 : 1936 **Laminated synthetic resin bonded sheet (fabric base) for use as gear material.** AS* NZ

14pp. 2s. 6d.

The specification covers one grade of sheet ⅛ in. to 4 in. thick, of medium to high mechanical strength and wearing properties. The finish is stated and test requirements for tensile, compression, cross-breaking and machining tests are given. Water absorption and effect of hot oil are specified and methods of measuring and testing described.

678 : 1952

3s. 6d. Add September, 1952.

Carboys and carboy hampers.

684 : 1950 **Methods of analysis of oils and fats.**

91pp. 10s. 6d. Amendments PD 1040, May, 1950; PD 1268, September, 1951; PD 1970, September, 1954.

Combining both present British Standard methods and methods agreed by the International Commission for the Study of Fats. The following British methods are provided:
Preparation of sample; determination of volatile matter and water, water insoluble solvent, ash, impurities, sodium soap, iron, saponification value, unsaponifiable matter, acidity, iodine value, thiocyanogen value, fatty acid composition, hydroxyl value and acetyl value, volatile acids, peroxide value, oxidised fatty acids, melting point, specific gravity, apparent density, refractive index. The following international methods are also provided:
Oleaginous seeds (size of sample, separation of impurities, grinding, moisture, oil content), moisture and volatile matter, impurities, ash, acidity, unsaponifiable matter, density, refractive index, insoluble fatty acids titre, saponification value, iodine value, hydroxyl number, oxidised acids, and polybromide number.

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729 : 1937 **Testing the zinc coating on galvanized articles other than wire (copper sulphate test and visual examinations), methods of.** NZ
10pp. 2s. 6d. Amendment PD 339, February, 1945.
This specification deals with tests for the zinc coating on articles such as bolts, nuts and washers, plates, bars, tubes and fabricated articles up to 3 ft. long and a section of not more than 3 in. in width or 2 in. in diameter. Castings of overall size not greater than 8 in. by 6 in. by 4 in. and weight not more than 8 lb. and surface not greater than 120 sq. in. are covered also. The method of preparing the copper sulphate solution and using it is described.

740 : —— **Portable fire extinguishers.**
740 : Part 1 : 1948 Portable fire extinguishers of the foam type.
20pp. 2s. 6d. Amendments PD 1364, April, 1952; PD 2293, September, 1955.
The class of extinguisher to which this standard applies is that in which the pressure to expel the contents is generated by the chemical action of an acid salt solution stored in an inner container of an extinguisher in conjunction with a carbonate or bicarbonate solution in combination with a stabiliser stored in an outer container of an extinguisher, which when combined with the acid salt will produce foam. The standard gives the requirements of the materials used, the type and dimensions of the various parts, the details of riveted, lock-joint and welded construction. Tests and markings are also covered.
This standard originally formed part of B.S. 740, "Portable chemical fire extinguishers of the foam and carbon tetrachloride type."

741 : 1937 **Flameproof electric motors; embodied in or designed for operating conveyors, coal-cutters, loaders and other purposes for use in mines.** NZ
25pp. 4s. Amendment PD 296, October, 1944, superseding previous amendment.
This specification covers mining gear for voltages not exceeding 650 v. and to comply with the Coal Mines Act, 1911. A definition of the term flameproof enclosure is given, also particulars of constructional requirements, tests specified, and details of connections and electrical performance required. Rating times are included primarily to give a basis of comparison and makers are not debarred from stating additional ratings for special conditions in certain cases.

747 : 1952 **Classification of roofing felts (bitumen and fluxed pitch).** SA
28pp. 5s.
The classification is divided into four main sections covering bitumen felts (fibre felt), bitumen felts (asbestos base), fluxed pitch felts, impregnated flax felts and hair felts. The various types of felt are described together with their uses, requirements for constituent materials, standard weights and standard packages. Notes on the use of roofing felts are given in an appendix.

767 : 1951 2s. 6d.
Hydro-Extractors and centrifugal machines.

771 : 1948 **Synthetic resin (phenolic) moulding materials.**
40pp. 6s. Amendments PD 2159, April, 1955; PD 2366, December, 1955.
This British Standard lays down mandatory requirements for the following properties of eight types of phenolic moulding materials:—tensile strength, impact strength, surface resistivity, volume resistivity, heat resistance, power factor and permitivity.
The Standard also lays down optional requirements, any of which may be specified by a purchaser, for water absorption, plastic yield, electric strength and acetone-soluble matter.
Methods of test for each of the specified mandatory and optional properties are given and methods of test are also provided for powder density and bulk factor, flow properties of powder, shrinkage on moulding, density of mouldings, crushing strength, crossbreaking strength, shear strength and elastic modulus in tension.

B.S.

776 : 1938 **Materials for use in the manufacture of magnesium oxychloride flooring compositions.**

32pp. 6s.

The materials are calcined magnesite, magnesium chloride, fillers (wood flour, sawdust, and ground silica), and pigments. For calcined magnesite, quality, composition, density, fineness, setting time, and strength are specified; and for magnesium chloride, quality and composition. Quality, moisture content, resin content, fineness, and matter soluble in water are specified for fillers. Pigments are described, and clauses deal with colour and staining power, matter soluble in water, and ether extract.

784 : 1953 **Methods of test for chemical stoneware.** NZ

20pp. 3s.

The apparatus, test piece and methods of testing tensile strength, resistance to compression, cross-bending, impact and abrasion, are described and the determination of power density, apparent density (porosity), water absorption, specific heat, thermal expansion and conductivity, and acid soluble iron, acid solubility and chemical resistance is specified. A method of determining resistance to thermal change is given.

799 : 1953

10s. Add June, 1954, and September, 1955.

Oil burning equipment.

810 : 1950 **Sheet linoleum and cork carpet.**

12pp. 2s. 6d. Amendment PD 1137, February, 1951.

Plain, marble, moire and jaspe sheet linoleum and two types of cork carpet are covered by this standard. Their quality is determined by reference to the gauge (thickness). The materials to be used in the mix and the method of sampling and testing the finished products for surface finish, seasoning, water absorption, bending and indentation are given, together with the width and length of the roll and the quality of the backing canvas. A simple apparatus is indicated for making the indentation test.

814 : 1950

2s. Add September, 1955.

Mild steel drums (light duty-fixed ends).

815 : 1938 **Under-floor non-metallic ducts for electrical services, with fittings.**

22pp. 5s.

The object of this specification is to provide a standard non-metallic under-floor duct system for electrical services for incorporation in buildings under construction. Tests are prescribed for: dimensions, mechanical and fire-resisting properties, galvanizing or sherardizing enamel, and continuity of bonding devices.

838 : 1939 **Method of test for the toxicity of wood preservatives to fungi.**

17pp. 3s. 6d.

The wood block method of test has been developed as the standard test. The standard deals with culture vessels, medium for growing cultures, species of wood used for test, treatment of blocks, infection of blocks, test fungi, duration of test, examination of test blocks after exposure to fungi attack, and evaluation of results. A description of the test fungi is given in the appendix.

844 : 1951 **Sampling and testing vegetable adhesives.** NZ

16pp. 2s.

Applies to adhesives manufactured from starch or material containing a high proportion of starch, e.g., crystal gums, dextrins and water soluble pastes and powders.

The tests cover determination of volatile content, acidity and alkalinity, *p*H value, ash, chemical residues, borax, colour, efficiency of adhesion foam, keeping quality and consistency.

B.S.

849 : 1939 **Plain sheet zinc roofing, code of practice for**
16pp. 3s. 6d. Amendment CF 2877, June, 1939.
Part 1 is a specification for zinc sheets for building, and contains requirements in respect of: quality of material, freedom from defects, stamping, dimensions, gauge, and bending test. Part 2 is a code of practice, and gives the requirements relating to the details of construction for the roofing and the method of laying zinc on different roof forms.

851 : 1952 **Manufactured oxides and hydrated oxides of iron (marigold, brown, maroon, yellow).** NZ
12pp. 2s. 6d.
Covers description, composition, residue on sieve, oil absorption value, colour, tone and staining power, loss on drying *in vacuo*, matter soluble in water, together with descriptions of sampling procedure and the methods of test.

868 : 1950 **Cod oil for sulphonation.**
15pp. 2s.
This specification covers specific gravity and density, iodine value and saponification value and includes limits for acidity and unsaponifiable matter. Sampling and test methods are described.

913 : 1954 **Pressure creosoting of timber.**
16pp. 2s. 6d.
This specification covers the methods of preserving timber normally in use in this country. The quality of the creosote is specified together with the condition of the timber, incising, penetration, stacking in cylinder maximum oil pressure and temperature, full-cell or Bethell process, and empty-cell or Rueping process. Details of the method for the determination of moisture content; absorption schedule; and a diagram showing spacing of incision for squared timber are given.

927 : 1940 Pigments for paints, alternatives for lead and zinc chromes (withdrawn, see B.S. 282 and B.S. 389).

928 : 1940 Pigments for paints, alternatives for Brunswick or chrome greens and green oxides of chromium (withdrawn, see B.S. 303 and B.S. 318).

929 : 1947 **Ready mixed oil paints.**

954 : 1941 **Lac.** NZ*
31pp. 5s. Amendment PD 2278, September, 1955.
In this specification, the special requirements of different users of lac have been met by detailing first those clauses which apply generally, irrespective of use, followed by clauses which have a specific application as, for example, to electrical use. The requirements concern form and condition, sampling and physical and chemical properties. The methods of test are described.

970 : 1955 12s. 6d. Amendment PD 2971, March, 1958.
Wrought steels in the form of bars, billets and forging up to 6 in. ruling section, for automobile and general engineering purposes.
German translation available. 12s. 6d.

987 : 1942 **Camouflage paints.**†
21pp. 3s. Appendix F of B.S. 987 "Camouflage paint surfaces chart" is issued as a separate document. Ref. No. CG. 579 7pp. 6d.
Requirements are stated in respect of: consistency; opacity, colour and finish; drying time; reflection value; water resistance; cement test; accelerated weathering test; and hardness test. For paint for application to asphalt or bituminous surfaces there is also a special requirement in respect of composition. The methods of test are described in appendices. Recommendations as to the treatment for different surfaces, are summarised in a chart.

B.S.

987C : 1942 Camouflage colours.†

Four plates. 7s. 6d. Amendments PD 315, December, 1944; PD 370, July, 1945.

This consists of a series of plates showing standard colour shades for camouflage paints.

988 : 1941 Mastic asphalt for roofing, type A (limestone aggregate).

13pp. 2s. 6d. Amendments PD. 386, August, 1945; PD 1531, November, 1952.

This specification provides for the following types of material, designated as type A: Mastic asphalt for roofing composed of limestone aggregate incorporated with either:

a. Asphaltic bitumen, or

b. Equal proportions of asphaltic bitumen and refined lake asphalt.

Grading of aggregate, properties of asphaltic cement, composition by analysis of mastic asphalt, and hardness are prescribed. Recommendations for application of mastic asphalt, and notes on the treatment of surfaces with paint for camouflage or other purposes, are included.

989 : 1944 Bitumen and fluxed pitch roofing felts. (Superseded by B.S. 747.)

996 : 1942 Test code for the performances of drying ovens and commercial acceptance tests of fuel-fired bakers' ovens.

81pp. 10s. 6d.

This test code applies to direct-fired and indirect-fired ovens (fired by solid, liquid or gaseous fuels) including amongst others, those for the drying of ceramic products, paints and enamels, corn and food products. Two types of test are covered, an industrial test for ordinary commercial use, and a comprehensive test for research and similar purposes. The code is readily adaptable to provide for the commercial testing of special types of drying ovens and, as an example, a commercial acceptance test for bakers' ovens has been included in an appendix. The codes contain all the necessary data for the determination of the performance of the plant, together with a full explanation as to how the necessary observations should be made.

997 : 1951 Sperm oil.

20pp. 2s. 6d.

Covers Part 1, Crude sperm oil, and Part 2, Filtered sperm oil. It includes limits for volatile matter and dirt, iodine value, colour, specific gravity, acidity and unsaponifiable matter, in the case of crude sperm oil, and specific gravity, iodine value, viscosity, cold test, acidity and unsaponifiable matter, in the case of filtered sperm oil, together with methods of test.

1014 : 1942 Pigments for colouring cement, magnesium oxychloride and concrete.

16pp. 3s. NZ SA

The specification is in seven parts, referring respectively to: chromium oxide, manufactured hydroxides of chromium, red oxide of iron, carbonaceous blacks, black oxide of iron, yellow oxide and hydroxide of iron (including natural ochres), and brown oxide of iron (including sienna and umber). In each case the material is described, and requirements laid down in respect of composition, colour and staining power, etc. Sampling and testing are described in the appendices.

1018 : Part 1 : 1942 Timber in building construction: floors. (Withdrawn see CP 112.)

12pp. 2s.

Grading and working stresses are referred to B.S. 940, Parts 1 and 2. The condition of timber, the floor loading used in calculations and the construction of floors are specified. Methods for determining moisture content are given.

TECHNICAL DATA

B.S.

1033 : 1942 **Priming paint (lead base) for the protection of steel sheet.†**
10pp. 2s. 6d. Amendment CG 510, May, 1942.
Five types of paint are covered by this specification, of which types 1 and 3 are stoving paints, and types 2, 4 and 5 are air drying paints. Requirements are stated in respect of: composition; drying time, opacity, colour and finish; consistency; skins and coarse particles; water content; flash point; protection against corrosion, keeping qualities; and packing and marking of packages. Sampling technique and the methods of test are described in the appendices.

1045 : 1942 3s. Add June, 1942 and September, 1945. Manganese steel gas cylinders for atmospheric gases.

1053 : 1950 **Water paints and distempers.**
10pp. 2s. 6d. Amendment PD 2428, January, 1956.
Provides for the following types:
Type A. Water paints, washable, oil bound.
Type B. Distempers, washable, oil free (paste or powder).
Type C. Distempers, non-washable, oil free (paste or powder).
Requirements are given for consistency, colour and finish, water content, oil or varnish content, pigment content reflectance value, resistance to dry rubbing, re-coating and keeping properties. Sampling and methods of test are described in appendices.

1067 : 1942 **Coal tar pitch felt damp-proof courses for temporary wartime buildings.†**
4pp. 1s. 6d.
This specification has been prepared as coal tar pitch is likely to be the only material suitable as an alternative during the war for bitumen felt damp-proof courses referred to in B.S. 743. It is intended to be used for temporary wartime buildings only, and is not at present considered a suitable alternative for use in permanent construction. Clauses cover base material, saturation of felt, pitch properties of saturant and of heavy creosote oil, sand surfacing, weight of finished felt, and standard packing.

1070 : 1956 **Black paint (tar base).**
20pp. 3s.
This specification provides for two types of tar-base black paint, viz. Types A and B, which are quick-drying and slow-drying respectively. The material is described and its general characteristics indicated. Requirements are laid down in respect of: water content; loss on heating; flash point; drying properties; resistance to salt water; permeability; flexibility; storage properties; packing; and thinners. Sampling technique and methods of test are given in the appendices. The foreword describes a method for the preparation of a simple black paint.

1076 : 1956 **Mastic asphalt for flooring (limestone aggregate).**
16pp. 3s.
This specification provides for mastic asphalt for flooring composed of limestone dust and coarse aggregate incorporated with either (a) Asphaltic bitumen, or (b) Equal proportions of asphaltic bitumen and refined lake asphalt. The specification is in several parts covering definitions of terms: gauges of materials and properties of asphaltic cement; composition, grading of limestone, coarse aggregate, characteristics of mastic asphalt, hardness number, inspection; marking; and remelting on site of work. Appendices give test methods for the determination of the calcium carbonate content of fine aggregate, the acid-soluble content of siliceous aggregate and the hardness number of the mastic asphalt.

1088 : 1951 **Plywood for marine craft.**
31pp. 4to. 10s. Amendment PD 2245, August, 1955.
A single high-grade plywood of three or more plies is specified to meet structural requirements of marine craft. The standard covers definitions; cutting of veneers; limits of undesirable characteristics; requirements for manufacture and limits of manufacturing defects; the adhesive; condition and finish; dimensions and marking. Sampling methods are described, and appendices give tests for moisture content, adhesion (wet and dry) by means of the knife test, and notes on preservative treatment.

B.S.

1097 : 1958 **Mastic asphalt for tanking and damp-proof courses (limestone aggregate).**
4s. 6d.

The properties of asphaltic cement and dimensions of sieves are prescribed, and other matters dealt with include grading of limestone, presence of grit, characteristics of mastic asphalt, and hardness number remelting on site of work, and recommendations for application of the mastic asphalt.

1101 : 1943 **Pressure paint containers.** AS*
23pp. 2s. 6d. Amendments May, 1943; PD 262, June, 1944; PD 282, September, 1944.

This specification applies to pressure paint containers, i.e. vessels used for the purpose of paint spraying by compressed air, not exceeding 36 in. in diameter and working at a pressure not exceeding 100 lb. per sq. in. It does not apply to containers of the "knapsack" type. Requirements are laid down in respect of the quality of material, construction and workmanship, and inspection and testing of the containers.

1128 : 1943 **Recommendations for primers for camouflage paints for asbestos-cement concrete, cement, cement bricks and sand-lime bricks.†**
14pp. 2s.

The finishing paints recommended for the surfaces listed in the title are of the following types: oil-bound water, bituminous, emulsion, and wool-grease emulsion paints. Part 1 of this specification comprises a chart giving recommended primers for use with these paints on normal surfaces classified according to their condition in respect of painting needs. Part 2 gives descriptive notes on primers. Part 3 gives notes on essential conditions to be observed in the application of paints.

1137 : 1949 **Synthetic-resin bonded-paper sheets for use at power frequencies.** NZ
24pp. 4s. Amendments PD 1792, January, 1954; PD 1839, March, 1954.

This British Standard covers sheets of thickness from 1/64 in. up to 1 in., the material being intended for electrical insulation purposes for use with direct current, and with alternating current of frequencies up to 100 c/s only. The specification is divided into Part 1, mandatory clauses, and Part 2, optional clauses. Amongst the former are requirements for finish, tolerance on thickness, electric strength along laminae, tensile strength, water absorption and resistance to hot oil. The optional clauses cover insulation resistance, power factor and mechanical properties. This specification supersedes B.S. 316 and B.S. 547 in so far as they applied to sheets.

1143 : 1955 **Special salt-glazed ware pipes with chemical resistant properties.**
28pp. 4s.

These specifications provide for salt-glazed ware pipes and fittings having chemically resistant properties. The range of sizes covered is 3 in. to 36 in. diameter. The dimensions for these are given and are identical with those for the standard drain-pipes. A special test for chemical resistance is included. The hydraulic pressure test is higher than that for ordinary drain pipes.

1149 : 1944 **Testing of lacquers for the internal coating of thermally processed food cans.† (Withdrawn.)**

1176 : 1944 **Air drying black paint for cooking appliances.†**
12pp. 2s.

This specification provides for two types of paint: one for temperatures up to 150° C. and the other for use at temperatures up to 230° C. The specification requirements laid down cover flash point, drying time, resistance to grease, corrosion resistance, resistance to heat, flexibility, etc.

The appendices deal with methods for carrying out the tests.

B.S.

1191 : 1955 Gypsum and anhydrite building plasters.
26pp. 4s. Amendments PD 392, September, 1945; PD 1555, January, 1953.
This specification deals with four types of plaster, i.e.:
Plaster of paris.
Retarded hemihydrate gypsum plaster.
Anhydrous gypsum plaster.
Keene's or parian;
and for each type covers the chemical composition, purity, freedom from coarse particles, soundness, transverse strength, and where applicable, mechanical resistance and expansion on setting, together with the appropriate methods of test.

1203, 1204 : 1945 Synthetic resin adhesive for wood.
26pp. 4s. Amendments PD 1090, September, 1950; PD 1416, June, 1952; PD 1580, February, 1953.
1203. Synthetic resin adhesives for plywood (phenolic and aminoplastic)
1204. Synthetic resin adhesive for wood (phenolic and aminoplastic).
B.S. 1203.—The three types of hot and cold setting adhesives specified are classified in terms of their durability under exposure to weather by means of simulative laboratory tests. Immersion for prescribed periods in cold, hot or boiling water, or steam are the distinguishing requirements of the revised standard.
B.S. 1204.—The corresponding standard for synthetic adhesives for constructional work in wood has been circulated for comment. A large scale trial for the application of a knife test to low density timbers (e.g., Gaboon, African Mahogany) is now in progress in connection with the preparation of a further specification.

1215 : 1945 Oil stains.
6pp. 2s. 6d.
This specification provides for oil stains mainly for the finishing of builders' joinery in normal house building work. It gives a general description of the stain, together with tests for colour, light fastness, drying and resistance to rubbing, and effect on varnish.

1224 : 1953 Electroplated coatings of nickel and chromium.
16pp. 2s. 6d.
Covers coatings of nickel and chromium on steel, copper, copper alloy, zinc alloy. It gives limits of finish, thickness and adhesion and specifies a salt spray test. Appendices give method of carrying out the tests.

1225 : 1945 Polarographic and spectrographic analysis of high purity zinc and zinc alloys for die casting, recommended methods for
36pp. 4s.
The standard covers methods of sampling and recommended methods for carrying out determinations for the quantities of impurities in high purity zinc and zinc alloys by the use of the polarographic and spectrographic method.
The publication gives details of the method of carrying out the test, the equipment to be used and the various solutions that are necessary. Recommendations for the interpretation of the results are also included.

1262 : 1953 Tins for paints and varnishes and other liquid products of the paint industry.
16pp. 2s. 6d.
Lays down (a) The types of tins for the liquid products of the paint industry within the general classification given in Clause 2; (b) The diameters and gross lidded volumes of round tins (lever type, taper top, round drawn top and flat top); (c) The gross lidded volumes of square and oblong flat top (pourer type) tins; (d) The performance rating and method of fabrication appropriate to each combination of product and type of tin; and (e) Method of measuring the gross lidded volume.

1269 : 1945 Titanium pigments for paints. (Superseded by B.S. 1851. Included in B.S. 239.)

B.S.

1282 : 1945 Classification of wood preservatives.
8pp. 3s. 6d. Amendment PD 660, July, 1947.
The classification, which excludes mixtures of tar and petroleum oils, defines the three main groups of wood preservatives; tar oil types including coal tar creosote, organic solvent types and water solution types. Notes are included dealing with application and use.

1310 : 1950 Coal tar pitches for building purposes.
22pp. 3s.
Provides for seven pitches for building purposes comprising five normal high temperature pitches graded according to their softening point in terms of the ring and ball test, and two special pitches for use in pitch mastic flooring, i.e., low temperature pitch and steam-blown high temperature pitch. The general characteristics are specified and methods of test are included for softening point, specific gravity, matter insoluble in toluole, ash, water content, distillate, and in the case of special pitches, for fuming. The methods of test are based on those given in the S.T.P.T.C. "Standard methods for testing tar and its products."

1316 : 1946 Fluorescent and phosphorescent materials (excluding radio-active materials).
28pp. 5s.
This is a re-issue, with slight amendment, of the war emergency specification B.S./A.R.P. 18. It covers luminescent materials in the form of paints, painted panels, plastics, vitreous enamel, etc., for indoor and outdoor use. The term "apparent brightness" is defined, and a classification of fluorescent and phosphorescent materials is given. Performance requirements and the appropriate methods of test are prescribed. Some notes on the use of luminiscent materials are appended.

1317 : 1946 Wood laths for plastering.
6pp. 1s.
The specification covers sawn laths for plaster work by setting out the species of timber, limits of defects, dimensions and packing.

1318 : 1955 Wood battens for slating and tiling.
8pp. 2s.
The Standard covers roof battens suitable for fixing tiles, pantiles, slates or other small rigid roof coverings but not including types requiring battens running with the slope of a roof, or counter battens.
The Standard provides for the use of a variety of timbers and limits for permissive defects. Dimensions are laid down, together with information on packing.

1322 : 1946 Synthetic resin (amonoplastic) moulding materials and mouldings.
28pp. 5s.
The materials and mouldings are classified into two types, one of which has the greater tensile strength, impact strength and electric strength. The section of the specification covering materials gives requirements, for each type, for tensile strength and impact strength; water absorption and swelling after immersion in water. Plastic yield, electric strength and surface resistivity. Methods of test for these and for other properties are specified.
The section covering mouldings gives requirements for density, degree of cure, finish and freedom from moulding defects.

1323 : 1946 Synthetic-resin bonded-paper sheet (thermosetting) for use in the building industry. NZ
14pp. 2s.
The specification covers sheet for use as wall board or for veneering on to wood or other surfaces.
It describes the class of material available and specifies types of panels and sheets, together with the requirements applicable to each type. These requirements include appearance and finish; size and thickness, with tolerances; flatness, straightness of edges and squareness; cross-breaking and impact strength; water absorption; resistance to marking with hot water, alcohol liquids, and hot edible fats; also resistance to dry heat, damp heat and to spread of flame.

B.S.

1333 : 1946 Acid-resisting silicon iron pipes and pipe fittings (elbows, bends, tees, crosses). NZ

24pp. 3s.

Deals with the dimensions and high silicon iron pipes and pipe fittings from 1 in. to 12 in. bore of two types—cone end for use with loose half coupling flanges (of ordinary cast iron) and spigot and socket. The spigots of the spigot and socket pipes are generally similar to the ends of the cone end pipes to allow inter-connection. The sockets of the spigots and socket pipes allow inter-connection with the spigots of chemical stoneware pipes of the same nominal base. The fittings specified are two types suitable for the respective kind of pipe.

1339 : 1946 Humidity of the air. Refinitions, formulae and constants.

8pp. 2s. 6d.

The terms recommended for use in hygrometric measurement are defined, and simple formulæ are given for determining the vapour pressure and indirectly the moisture content, absolute humidity, density, humid volume and total heat of moist air, from wet and dry-bulb temperature readings. Each formula is accompanied by a table of constants for various systems of units.

1358 : 1947 Colours for vitreous enamel finishes.

2s. Amendment PD 683, September, 1947.

This card provides for fourteen colours for vitreous enamels which have been produced through the co-operation of the British Colour Council and the Institute of Vitreous Enamellers. In addition to giving colour specimens the card also gives the calorimetric values for each colour based on the international system of colour specification. The percentage brightness factor is also given.

1375 : 1947 Coloured pitch mastic flooring.

16pp. 2s. 6d. PD 1526, December, 1952.

This specification provides for red and brown pitch mastic flooring composed of pigment, fine aggregate and coarse aggregate, incorporated with a binder consisting of coal tar pitch suitably fluxed.

The requirements with regard to the quality of the materials used in preparation of the mastic and the methods of test are laid down. Pitches and fluxes have been specified which will ensure absence of irritant fumes during laying.

The specification also includes definitions of terms, grading of the aggregate, process of manufacture, sampling, colour, hardness number, inspection and marking. Recommendations for application of the flooring are included in an appendix.

1391 : 1952

5s. Add. August, 1954.

Performance test for protective schemes used in the protection of light-gauge steel and wrought iron against corrosion.

1410 : 1947 Mastic asphalt flooring—natural rock containing 6 to 10 per cent. bitumen.

14pp. 2s. 6d.

This British Standard provides for mastic asphalt for flooring composed of natural rock asphalt incorporated with an asphaltic cement composed of equal proportions of asphaltic bitumen and refined lake asphalt and subsequently the addition of coarse aggregate. It is divided into several parts covering definitions and terms; the properties of the asphaltic cement; natural rock asphalt and coarse aggregate; the method of manufacture; the characteristics of mastic asphalt; marking and re-melting on site. An appendix gives recommendations for application of mastic asphalt flooring.

B.S.

1418 : 1947 **Mastic asphalt damp-proof courses and tanking—natural rock containing 6 to 10 per cent. bitumen.**
16pp. 2s. 6d. Amendment PD 783, May, 1948.

This British Standard provides for mastic asphalt for damp-proof courses and tanking composed of suitable crushed natural rock asphalt incorporated with either fluxed refined lake asphalt or equal proportions of asphaltic bitumen and refined lake asphalt. The standard covers: definitions; the properties of asphaltic flux oil; the properties of asphaltic cement; the specification of the natural rock asphalt and the grit to be used. It also covers the manufacture of the mastic asphalt, and its characteristics, which are based on composition by analysis. Inspection, marking, sampling and testing are dealt with. Recommendations for the application of mastic asphalt damp-proof courses are incorporated in appendices pending the issue of a code of practice.

1441 : 1948 **Galvanized high tensile steel wire for armouring submarine cables.**
8pp. 2s.

This British Standard covers the requirements for galvanized high tensile steel wire, in sizes ranging from 0.083 in. to 0.134 in. for armouring submarine cables. Methods of test, test requirements and tolerances are specified and details are provided relating to selection of test samples, re-tests, galvanizing, size and weight of coils and packing and identification.

1444 : 1948 **Cold-setting casein glue for wood.**
8pp. 2s. Amendment PD 1090, September, 1950.

This British Standard covers glue in the form of powder, the adhesive constituent of which is mainly casein. It provides for two types, one of which has a limited degree of water resistance, no water resistance performance being claimed for the second type.

1448 : 1948 **Nomenclature of decorative metallic finishes.**
6pp. 4 plates. 2s. 6d.

The object of this standard is to enable the purchaser of metal articles finished by metal colouring to obtain a standard finish without the necessity of submitting a sample. The finish is defined by its nature, its colour and the relief of the colour, plates being included to assist in the description. A method of designation is provided which clearly defines the finish.

1468 : 1948 **Tin salts for electroplating.**
12pp. 2s.

This standard includes two specifications for electroplating, one for stannous sulphate and one for sodium stannate. It lays down the chemical composition and limits the impurities. Methods of test and sampling are provided in appendices.

1485 : 1948 **Galvanized wire netting.**
8pp. 2s. 6d.

Containing details of the mesh, gauge and widths of netting together with minimum weights and tolerances. It also includes recommended applications of particular sizes of mesh.

1493 : 1958 **Polystyrene moulding materials.** NZ
4s.

Covers four types of polystyrene moulding materials classified by their softening point. Acceptance limits for the properties of each of these grades are specified, together with standard methods of testing these properties. The more important properties covered are sieve analysis, methanol soluble matter, volatile matter, viscosity in benzene, impact strength, softening point, power factor, and permitivity. A marking clause is also included.

B.S.

1499 : 1949 Sampling of non-ferrous metals.
8pp. 1s.
Gives general guidance in the sampling of non-ferrous metals. The general recommendations do not apply to metals covered by any British Standard which itself includes sampling instructions.
The standard covers the sampling of both liquid and solid metals.

1500 : 1949.
25s. Add. September, 1950, and July, 1952.
(Provisional). Fusion-welded pressure vessels for use in the chemical and allied industries.

1507/8 : 1950 Steel pipes and tubes for pressure vessels for use in chemical and allied industries. NZ
38pp. 4to. 10s. 6d. Amendment PD 1184, May, 1951.
Contains specifications covering pipes and tubes in mild steel, alloy steel and austenitic steel. Full chemical compositions and mechanical properties are given, together with methods of test and tolerances on the finished article.

1524 : 1955 Cellulose acetate moulding materials. NZ
36pp. 6s. Amendments PD 944, August, 1949; PD 1082, August, 1950.
Deals with cellulose acetate material for injection and compression moulding. The standard specifies methods of test and qualifying requirements for the physical properties of three grades of material, which are distinguished by different softening points.
The standard also lays down optional requirements for electric strength, fines and impurities, and colour bleeding; any of which may be specified by a purchaser.

1547 : 1949 Flameproof industrial clothing (materials and design).
12pp. 3s. 6d.
Applies to materials for flameproof industrial clothing. The standard specifies a method of test for material; it deals with the effect of any flameproofing treatment on the strength of materials; and gives requirements for the marking of material flameproofed with soluble deposits. Essential points of design are also covered and recommendations on maintenance are given.

1554 : 1949 Rust, acid and heat resisting steel wire.
12pp. 2s. Amendment PD 1199, June, 1951.
An extension of, and should be regarded as a companion to B.S.970 "Wrought steels," to provide more fully for rust- acid- and heat-resisting steels commonly supplied in the form of wire for general engineering purposes. Section One covering general clauses, includes details of manufacture, methods of test and tolerances; Section Two gives, for each steel, the chemical composition and mechanical properties.

1561 : 1949 Silver anodes and silver salts for electroplating.
8pp. 2s.
Provides a detailed specification for silver anodes, silver cyanide (single salt) and silver potassium cyanide (double salt). Minimum silver content and maximum insoluble matter are dealt with, and methods for their determination are included.

1564 : 1949 Pressed steel sectional tanks (rectangular). NZ
20pp. 3s.
Deals with bolted sectional pressed steel tanks up to 52 ft. square and 16 ft. deep excluding supporting structures not subject to pressure other than static head. The tanks specified are with internal or external flanges, with open or closed tops made from unit plates 4 ft. square. Details are included of the thickness of unit plates, and staying and welded connections. Ten drawings, and four tables of approximate weights and nominal capacities for tanks with external flanges are provided.

B.S

1565 : 1949 Galvanized mild-steel indirect cylinders.
16pp. 3s.
One of a series of standards relating to domestic hot water storage vessels, the others being B.S. 417, B.S. 699 and B.S. 1566. It provides for a range of seven sizes of indirect cylinder in two classes, suitable for maximum permissible working heads of 60 ft. and 30 ft. respectively.
The standard deals with minimum thicknesses of material, minimum heating surfaces, methods of manufacture, radius of curvature, bolted ends and handholes, method of galvanizing, screwed connections for pipes and screwed connections for auxiliary electric heating. The latter provision gives a variety of methods so that purchasers may choose that most suitable for the operating conditions. The test requirements deal with primary heaters and complete cylinders. A marking clause gives the various marks to be added in all cases, and recommends the incorporation of further information likely to assist in installation.
All the main dimensions are set out in a table and drawings illustrate the methods of measuring them.
8pp. 2s. Amendments PD 1214, June, 1951; PD 2006, October, 1954.

1572 : 1949 Colours for flat finishes for wall decoration (Superseded by B.S. 2660).

1591 : 1949 Acid-resisting high silicon iron castings (Confirmed 1951). NZ
8pp. 2s.
Covers the requirements for acid-resisting high silicon iron castings for chemical engineering purposes.
The chemical composition of the castings and the procedure for chemical treatment, freedom from defects, porosity, repairs to castings, welding, marking and packing, and inspection and testing facilities.

1593 : 1950 Perchlorethylene. AS NZ
8pp. 2s. Amendments PD 1212, June, 1951; PD 2005, October, 1954.
Covers specific gravity and distillation range, and includes limits for residue on evaporation, alkalinity and free chlorine. Sampling and test methods are described.

1595 : 1950 Isopropyl alcohol. NZ*
Covers specific gravity, distillation range and miscibility with water, and includes limits for residue on evaporation and acidity. Sampling and test methods are described.

1615 : 1958 Anodised aluminium. NZ
7s. 6d.
Provides specifications for thickness of anodic coatings, reflection factors resistance to abrasion, and fastness to light together with methods of tests. It is pointed out that not all the specifications will be applicable to all types of aluminium.

1630/32 : 1950 Corrosion-resisting alloy steel castings. NZ
14pp. 3s. Amendments PD 1606, April, 1953; PD 2169, April, 1955.
Includes three specifications for corrosion-resisting alloy steel castings, viz., 13 per cent. chromium steel, austenitic chromium-nickel steel and austenitic chromium-nickel-molybdenum steel.
Within each specification there are several grades for which chemical composition and mechanical properties are specified. For the austenitic steels an intercrystalline corrosion test is required.
Details are included of the process of manufacture, fettling and dressing, freedom from defects, testing facilities, branding and repairs to castings.

1634 : 1950.
2s. 6d.
Dimensions for stoneware pipes and pipe fittings for chemical purposes.

1647 : 1950 pH scale.
12pp. 2s.
To ensure that, when different workers refer to a stated measured value

of *p*H, they mean the same thing within ± 0.0005. The standard applies only to aqueous solutions within certain temperature limits, and the definition adopted for *p*H is an operational, and to some extent an arbitrary one. Pure potassium hydrogen phthalate has been chosen as the primary standard. The *p*H value of a 0.05 molar solution of this primary standard is defined according to the most recent accurate measurements and, in addition, values are given for several secondary standards. Recommendations for the use and calibration of the glass electrode are included.

1651 : 1950 Industrial safety gloves.
36pp. 4s. Amendments PD 1128, January, 1951; PD 1513, November, 1952; PD 1911, June, 1954; PD 2402, February, 1956.
Covers safety gloves, mittens and hand guards made of leather, rubber, felt, polyvinyl chloride or cotton, for use in all industries. The standard specifies a range of seventeen preferred types of gloves and lays down requirements for size, materials and manufacture; methods of test are included, together with recommendations on the storing of rubber gloves and on the information to be given on ordering.

1702 : 1950 Mild steel drums (heavy duty—fixed ends).
14pp. 2s.
Covers construction and dimensions of heavy duty welded drums with capacities from 5-90 imperial gallons.
The 44 imperial gallon petroleum drum is also covered.
Materials, closures and methods of testing are specified.

1704 : 1951 General purpose thermometers. NZ
12pp. 2s. Amendment No. 1, PD 2932, January, 1958.
Includes liquid-in glass thermometers, for total and partial immersion, covering the most commonly used ranges of temperature between—120° C. and 510° C., and between—180° F. and 950° F. Toluene or pentane is specified for the lowest ranges (total immersion only) and mercury for the remainder. Constructional details and tolerances are specified; the graduation, dimensions and permissible errors of the thermometers having been selected in each case to make possible the manufacture of a good quality general purpose instrument in large quantities at a reasonable price.

1706 : 1951 Electroplated coatings of cadmium and zinc on iron and steel.
20pp. 3s. Amendment PD 1383, April, 1952.
Provides for essential qualities of electroplated coatings of cadmium and zinc on iron and steel articles. It covers three classes of coating, according to the conditions to which the article may be subjected. It also covers details of the requirements for passivated zinc coatings. The specification deals with the purity of the materials used for coating and with the finish and appearance of the plated surface, thickness of coating and adhesion. It includes appendices giving methods of test.

1710 : 1951 Colour identification of pipe lines.
13pp. 3s. Amendment PD 1846, April, 1954.
Replaces B.S. 457, B.S. 617 and B.S. 3011. Provides primary identification colours for pipe lines to indicate the class of content and the detailed identification of the contents by lettering or pipe colour rings. It is supplementary to any regulations laid down for public safety, and applies to pipes, conduits, ducts and cables and their covering. Includes illustrations in colour of the application of the code.

1721 : 1951 Portable fire extinguishers of the carbon tetrachloride type.
32pp. 6s. Amendments PD 1561, January, 1953; PD 1910, June, 1954; PD 2024, November, 1954.
Specifies the requirements for the materials used, the type and dimensions of the various parts, and details of riveted and welded construction. Tests and methods of marking are provided for.

B.S.

1728 : Part 1 : 1951 **Methods for the analysis of aluminium and aluminium alloys. Copper.**
8pp. 2s. Amendment PD 1187, June, 1951.
Reagents required, recommended methods of sampling and the test procedures (a) in the presence of antimony and (b) in the absence of antimony are specified. An appendix gives a statistical analysis of test results to indicate the reproducibility of the method.

1728 : Part 2 : 1952 **Determination of magnesium (mercury cathode method).**
12pp. 2s.
Reagents required, recommended methods of sampling and test procedures (a) for alloys having a silicon content less than 2 per cent.; and (b) for alloys having a silicon content greater than 2 per cent. are specified.

1728 : Part 3 : 1952 **Determination of zinc (mercuric potassium thiocyanate method).**
8pp. 2s.
Reagents required, recommended methods of sampling and test procedures are specified.

1728 : Part 4 : 1952 **Determination of zinc (polarographic method).**
12pp. 2s. Amendment PD 1462, August, 1952.
Specifies reagents required, recommended methods of sampling and test procedure.

1728 : Part 5 : 1953 **Determination of copper (absorptiometric method).**
8pp. 2s.
Specifies reagents required, recommended methods of sampling and test procedure.

1728 : Part 6 : 1955 **Determination of iron (volumetric : titanous chloride method).**
8pp. 2s.
Specific reagents required, recommended methods of sampling and test procedure.

1728 : Part 7 : 1955 **Determination of zinc (zinc oxide method).**
8pp. 2s.
Specifies reagents required, recommended methods of sampling and test procedure.

1755 : 1951 **Glossary of terms used in the plastics industry.** NZ
59pp. 6s. Amendment PD 1594, 1953.
The glossary includes 450 terms which have been grouped in sections to cover:

Chemistry
Industrial applications
Constituents
Properties
Moulding processes
Other manufacturing processes

The terms listed in these sections are fully defined.

1782 : 1951 **Couplings for suction and delivery hose, other than fire hose couplings.**
46pp. 5s. Amendment PD 2321, October, 1955. NZ
Two types of couplings are specified in this Standard, the screw type and the swivelling-ring swing-bolt type. These couplings are intended for working pressures not exceeding 10 lb./sq. in. They have been designed primarily for use with water, but they may be used for other suitable liquids. The screw type couplings are also suitable for use with compressed air. This Standard deals with workmanship, interchangeability, marking and hydraulic testing of the couplings. Details of materials and screw threads are also given. The Unified form of screw thread has been adopted for these couplings. Illustrations of the couplings are included together with full dimensional particulars. Consideration is being given to the preparation of a British Standard for couplings for petrol, oil, and lubricants.

1795 : 1952 **Extenders for paints.** NZ
24pp. 3s.
Specifies requirements for asbestine, barytes Grades 1 and 2, blac fixe, witherite, precipitated barium carbonate, whiting, china clay Grades 1

B.S.

and 2, and kieselguhr. Clauses and methods of test cover composition, residue on sieve, oil absorption value, matter volatile at 98-102° C., matter soluble in water, colour and sampling. Special limits and tests for loss on ignition (for china clay), matter insoluble in hydrochloric acid (for precipitated barium carbonate and kieselguhr) and oxidizable sulphur compounds (for precipitated barium carbonate) are included.

1814 : 1952 **Marking system for grinding wheels.** NZ
8pp. 2s.
Relates to a marking system for grinding wheels designed to secure uniformity in the use of the symbols for various characteristics of the wheels and the sequence in which they are used. Symbols are specified to denote the following characteristics: abrasive, grain size, grade, type of bond. The Standard mentions in addition those symbols which the manufacturer may include at his own option. A diagrammatic illustration of the use of the marking system is included.

1815 : 1932 **Enamel (oleo-resinous) and cotton covered round copper wires.**
12pp. 2s.
Sets out the requirements of enamelled wires to B.S. 156, "Enamelled round copper wire (oleo-resinous enamel)," having a covering of cotton consisting of one or two layers, in which the cotton is applied by winding the yarn helically round the wire. It does not apply to such kinds of cotton covering as braiding. It includes all sizes of wires from 0·0050 to 0·160 in. in dia. and deals with four types of enamel and cotton-covered wires as follows:
Enamel and single cotton covering, Ordinary (En. and S.C.C. ord.),
Enamel and single cotton covering, Fine (En. and S.C.C. fine),
Enamel and double cotton covering, Ordinary (En. and D.C.C. ord.),
Enamel and double cotton covering, Fine (En. and D.C.C. fine).
The difference between the "Ordinary" and "Fine" coverings is in the thickness of the cotton covering.
It includes requirements for the cotton covering, elongation of the covered wire, measurement of the diameter of the enamelled wire and the overall diameter, and reels, reeling packing, wrapping and labelling.

1834 : 1952 **Isopropyl acetate.**
8pp. 2s.
Covers specific gravity and distillation range and includes limits for residue on evaporation, and water, acidity and ester content. Sampling and test methods are described.

1844 : 1952 **Enamelled round copper wire (enamel with vinyl acetal base).**
25pp. 5s. Amendments PD 1723, October, 1953; PD 1972, September, 1954; PD 2152, March, 1955; PD 2617, November, 1956.
Applies to round copper wire insulated with a synthetic enamel based on a vinyl acetal resin.
All sizes of wire from 0·002 to 0·160 in. dia. commonly in use are included. There are four classes, differing in the thickness of insulation, and the classes are designated Fine (F), Medium (M), Thick (T), and Extra Thick (X) respectively. It specifies details of the enamel, insulation, elongation of the enamel wire, continuity of covering and gives methods of test for the measurement of conductor diameter and overall diameter, hardness of enamel, electric strength, continuity of covering, together with a table of preferred sizes of conductor, and the diameters of the covered wires.

1872 : 1952 **Electroplated coating of tin.**
12pp. 2s. 6d.
Provides for the essential qualities of electroplated coatings of tin on fabricated articles of iron, steel, copper and copper alloys. It specifies requirements for five classes of coatings according to the use to which the coating is to be put. It provides details of sampling, finish, solderability, thickness, adhesion and heat treatment, together with the necessary methods of test.

1918 : 1953 3s. **Glass container finishes.**
a. Shallow continuous thread finish.
b. Tall continuous thread finish.

1940 : 1953 **Ethyl methyl ketone (methyl ethyl ketone).** NZ*
8pp. 2s.
Covers specific gravity, and distillation range and includes limits for

B.S.

residue on evaporation, water, acidity and alcoholic impurities. Sampling and test methods are described.

1941 : 1953 ***iso*Butyl methyl ketone (methyl *iso*butyl ketone).** NZ*
8pp. 2s.
Covers specific gravity, and distillation range and includes limits for residue on evaporation, water, acidity and alcoholic impurities. Sampling and test methods are described.

1961 : 1953 **Enamelled round copper wire (oleo-resinous enamel). Metric units.**
24pp. 4s. Amendment No. 1, PD 2929, January, 1958.
This is similar in all respects to B.S. 156 : 1951 except that all quantities are expressed in metric units.
All sizes of wire from 0·025 mm. to 4·0 mm. diameter are included. Details of diameters, resistances, and thickness of enamel (included tolerances) are specified, together with tests on the enamel insulation. These tests relate to hardness, flexibility and adherence, heat shock, cold test at 0° C. heat ageing and electric strength.

1973 : 1953 4s. **Polythene tube for general purposes, including chemical and food industry uses.**

2015 : 1953 **Glossary of paint terms.**
44pp. 6s.
Contains definitions of some 300 terms widely used in the paint industry, including the terms describing types of finishes, applications and defects of films. In general, the glossary does not include definitions of materials or processes used in the manufacture of paint.

2029 : 1953 **White oil pastes for paints.**
12pp. 2s. 6d.
Specifies requirements for unreduced qualities of white oil paste made of various materials. The composition of each paste is specified. Appendices include descriptions of sampling and the methods of test.

2064 : 1953 **Dimensions of diamond abrasive wheels and tools.**
24pp. 4s. Amendment PD 1818, February, 1954.
Specifies the dimensions and tolerances of the following tools in resinoid, vitrified and metallic bonds: Peripheral wheels, straight cup wheels, double cup wheels, taper cup wheels, dish wheels, cut-off wheels, chip breaker wheels, milling tools, hollow drills, stone saws and hones.

2086 : 1954 **White line road paint.**
8pp. 2s.
Covers the requirements for a white paint for marking carriageway surfaces and kerb surfaces. Tests for drying time, opacity, finish and brightness, fastness to light, bleeding and wearing are given those being related to the performance of a reference standard paint, the composition of which is specified. Requirements for keeping properties, marking of containers and sampling are also given.

2521 : 1954 **Oilbase paints.**
These standards include one lead base primer for wood-work, one leadless grey primer for interior use, three lead base primers for iron and steel and one red oxide primer for iron and steel. These priming paints are designed for use under undercoating and finishing complying with B.S. 2525-32, but can also be used under conventional hard gloss paints provided appropriate drying times are allowed before the applications of the undercoating.

2525 : 1932 These cover undercoating and finishing paints of the types known as "straight linseed oil paints." These British Standards do not apply to those types of paint known under such titles as hard gloss paint, enamel paint, etc., and the paints manufactured to these standards will not have the brushing properties or the finish and gloss of such types of paint. The paints are designed for the protection of exterior surfaces and are not for interior decoration.

2569 Parts 1 and 2. 2s. **Sprayed metal coatings.**
Part 1, Amendment PD 3009, May, 1958; Part 2, Amendment PD 3010, May, 1958.
The first covers the protection of iron and steel against atmospheric

corrosion, and the second the protection of the same basic metals by aluminium against corrosion at elevated temperatures.

SPECIAL ISSUES

PD 420 : 1953 Methods of protection against corrosion for light gauge steel used in building.

16pp. 3s.

Describes six grades of protective schemes for steel components not exceeding 0·128 in. in thickness used in general building construction. It also recommends the grades to be used under certain conditions of exposure. One part describes suitable surface preparations and paints. Points to be watched in designing construction of light gauge steel structures and components are the subject of part 7.

PD 539 : 1946 Recommendations for phosphate coatings as a basis for painting steel.

4pp. 1s. Amendment PD 803, July, 1948.

The issue of the above recommendations is an interim measure for the assistance of industry. Instructions are given on the method of application of satisfactory coatings and elementary tests of the suitability of the coating are described. Research is now in progress and it is intended to prescribe performance tests as soon as sufficient data are available.

CP 3 : —— Code of Functional Requirements of Buildings (Classification Code). CP 3 : Chapter IV : 1948 Precautions against fire.

11pp. 2s.

This chapter recommends precautions to be taken when siting, planning or constructing houses and flats having floor areas not exceeding 1,500 and 1,000 sq. ft. respectively, and any garages which may be nearby. A table is included setting out minimum distances of external walls from site boundaries, and the maximum number of houses or flats that should be contained in a block, having regard to the degree of fire-resistance and type of construction of the external walls. Recommendations are included on the design, form of construction and grades of fire-resistant, of separating walls erected between individual houses or as fire stops. Floors, chimneys and roofs are also considered. Guidance is given on the use of draught-stops in hollow constructions and on the provision of means of escape.

CP 231 : 1951 Painting.

166pp. 10s.

The code relates to the painting of buildings for the purpose of decoration, protection or hygiene. It includes a head code dealing with general considerations and sub codes on particular aspects of painting wood; plaster, concrete, brick and stone; lime; plaster; calcium sulphate, plasters; Portland cement concrete, plastering and rendering; brickwork; and stone masonry. The code deals with all important points in the processes involved and gives recommendations on matters ranging from the preparation stage to the application of the final cost.

CP 112.100 : 1952 Preservative treatments for timber in buildings.

20pp. 3s.

This code deals with the preservation of timber against fungal and insect attack and gives recommendations for the structural use of preserved timber in building including guidance on the choice of preservatives, the preparation of timber for treatment, the methods of treatment, and conditioning after treatment. The types of preservatives and their methods of application are related to the various uses of timber. This sub code is incorporated in Code 112, "The structural use of timber in buildings," and is also obtainable separately.

2569 : —— **Sprayed metal coatings.** NZ

2569 : Part 1 : 1955 Protection of iron and steel against atmospheric corrosion.
8pp. 3s. Amendment PD 2456, April, 1956.
Covers sprayed coatings of aluminium and zinc. It provides methods of surface preparation and application of the coating together with the requirements for the thickness and adhesion of the coatings. Methods of test are described in the appendices.

2569 : Part 2 : 1955 Protection of iron and steel by aluminium against corrosion at temperatures between 120° C and 950° C.
8pp. 3s. Amendment PD 2457, April, 1956.
Covers the spraying of aluminium and aluminium alloy only, but includes three processes for different applications. It provides methods of surface preparation and application of the coating together with the requirements for the thickness and adhesion of the coatings. Methods of test are described in the appendices.

2656 : 1956 **Zinc anodes, zinc cyanide and zinc oxide for electroplating.**
28pp. 4s. 6d.
Specifies the chemical composition and methods of test for zinc anodes, zinc cyanide and zinc oxide.

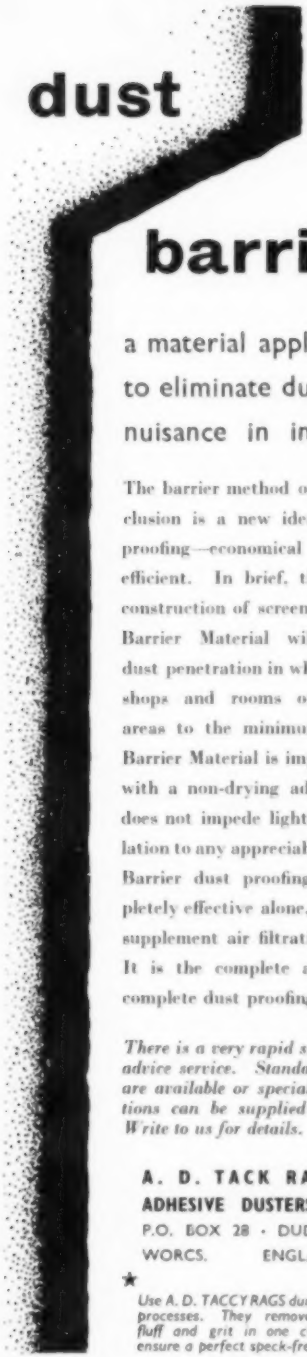
B.S.
2657 : 1956 **Fluoroboric acid and metallic fluoroborates for electroplating.**
24pp. 4s. 6d.
Specifies the chemical composition and methods of test for fluoroboric acid and metallic fluoroborates.

B.S.
2816 : 1957 **Electroplated coatings of silver for engineering purposes.**
20pp. 4s.
Provides for essential qualities of electroplated coatings of silver, and covers ranges of thickness for various basis metals.
It deals with the purity of the silver used for the coating and for the finish and appearance of the plated surface and its adhesion, and includes appendices giving methods of test, together with an appendix giving notes on silver plating.

2906 : 1957 **Aminoplastic mouldings.**
8pp. 3s.
Specifies material, freedom from moulding defects, dimensions, density, degree of cure, colour and sampling, with appropriate appendices.

2907 : 1957 **Phenolic mouldings.**
8pp. 3s.
Specifies material, freedom from moulding defects, dimensions, density, degree of cure, colour and sampling, with appropriate appendices.

2884 : 1957 **Copper cyanide for electroplating.**
10pp. 4s. 6d.
Specifies the chemical composition and gives details of methods of test.



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Bitumarka (Anti-corrosive paint) Robert Kearsley and Co.
Blacknick (Black plating salts) R. Cruickshank Ltd.
Blacolac (Black enamel) Robert Kearsley and Co.
Blaklac (Black bituminous paint) Pinchin, Johnson and Co.
Blue Grey (Bronze) W. Canning and Co. Ltd.
Bodylac (Varnish) Raines and Porter Ltd.
Bonderite (Paint bonding treatments for metal surfaces) The Pyrene Co. Ltd.
Bonderite SS (Surface treatment process for facilitating the cold forming of stainless steels and heat resistant alloys) The Pyrene Co. Ltd.
Bonderizing (Phosphating processes for bonding paint to metal surfaces and assisting the cold forming of steel) The Pyrene Co. Ltd.
Bonderlube (Lubricant designed for use with "Bonderite" coatings) The Pyrene Co. Ltd.
Bondvar (Electrical mica bonding varnish) Pinchin, Johnson and Co.
Brassit (Plating salts) R. Cruickshank Ltd.
Brassoline (Lacquer) Imperial Chemical Industries Ltd.
Brazoclene (Oxides and tarnish remover from copper and copper alloys) Sunbeam Anti-Corrosives Ltd.
Bricot (Nickel plating salts) The Hockley Chemical Co. Ltd.
Britannia (General range of industrial products) Robt. Ingham Clark and Co.
Britenick (Plating salts) R. Cruickshank Ltd.
Britewite (Barrel nickel plating salts) W. Canning and Co. Ltd.
Broadmead (White lead paint) John Hall and Sons (Bristol and London) Ltd.
Brolac (Enamels) John Hall and Sons (Bristol and London) Ltd.
Brolaceal (Plastic sealer) John Hall and Sons (Bristol and London) Ltd.
Brolistic (Oil-bound water paint) John Hall and Sons (Bristol and London) Ltd.
Bronzoid (Gold paint) Pinchin, Johnson and Co.
Broxil (Synthetic finishes) British Cellulose Lacquers Ltd.
Brovar (Varnish) John Hall and Sons (Bristol and London) Ltd.
Bruco (Scratch brushing compound) W. Canning and Co. Ltd.
Brustane (Scrumble) Goodlass, Wall and Co. Ltd.
Brytax (Bright nickel salts) W. Canning and Co. Ltd.
B.S.A.-Tinsley (Thickness gauge, for non-magnetic coatings) Evershed and Vignoles Ltd.
Bullneck (Leather bobs) W. Canning and Co. Ltd.
Bullows (Air compressors, spray painting equipment) Alfred Bullows and Sons Ltd.

Cabeliac (Black metal coating) Pinchin, Johnson and Co.
Cabinet (Glass paper) John Oakey and Sons Ltd.
Cadmas (Plating salts) R. Cruickshank Ltd.
Calaroc (Synthetic resin for paper and textiles) Imperial Chemical Industries Ltd.
Calatac (Leather and textile finishing agents) Imperial Chemical Industries Ltd.
Calesco (Washable paint) Thomas Smith and Son Ltd.
Calsolene (Wetting-out agent) Imperial Chemical Industries Ltd.
Cambridge (Scientific industrial instruments) Cambridge Instruments Ltd.
Canno (Felt buffing discs) W. Canning and Co. Ltd.
Cannoid (Lacquer) W. Canning and Co. Ltd.
Capacitrol (Electronic temperature controllers) Ether Ltd.

Capalla (Chemical pretreatment for steel) C. and P. Development Co. (London) Ltd.
Carbofuce (Heat treatment salt) Imperial Chemical Industries Ltd.
Carboneutral (Heat treatment salt) Imperial Chemical Industries Ltd.
Carub (Acid, alkali, and moisture resisting composition) Bitulac Ltd.
Cassel (Cyanides) Imperial Chemical Industries Ltd.
Carbryte (Car polish) Thos. Parsons and Sons Ltd.
Carrier (Thermal engineers and equipment) Carrier Engineering Co. Ltd.
Cats Head (Decorators' varnishes) Pinchin, Johnson and Co.
Cellabrase (Polishing liquid) Cellon Ltd.
Celletch (Self etching primers) Cellon Ltd.
Cellibon (Protective hand cream) Cellon Ltd.
Cellon (Aircraft finishes) Cellon Ltd.
Celloseel (Jointing compound) Cellon Ltd.
Cellostrip (Paint remover) Cellon Ltd.
Cellothin (Cellulose, synthetic, anti-corrosive paint) A. Learner and Co. Ltd.
Cellutone (Cellulose lacquer) Robert Kearsley and Co.
Celsyn (Half-hour cellulose synthetic coach or industrial enamel) British Cellulose Lacquers Ltd.
Cement Prodor (Acidproof cement) Prodorite Ltd.
Cementilk (Imitation stone paints) Pinchin, Johnson and Co.
Cemwood (Primers) Wm. Harland and Son Ltd.
Cereclor (Chlorinated paraffin wax) Imperial Chemical Industries Ltd.
Cerrax (Wax and liquid polishes) Cellon Ltd.
Cerric (Cellulose lacquers) Cellon Ltd.
Cerrux (Synthetic stoving and air drying finishes) Cellon Ltd.
Chartex (Cleaning salts—electrolytic) The Hockley Chemical Co. Ltd.
Chemiprufe (Clear lacquer) Tretol Ltd.
Chexrot (Wood preservative and stain) Thos. Parsons and Sons Ltd.
Chiemel (Synthetic enamels) W. H. Palmer and Co. Ltd.
Chow (Paint and varnish) George Purdom and Co.
Chromastral (Pigments) Imperial Chemical Industries Ltd.
Chromate Redlead (Rust preventative) Donald Macpherson and Co. Ltd.
Chromax (Tepid bright chrome solution) W. Canning and Co. Ltd.
Chromex (Anti-rust, orange primer) Sherwood's Paints Ltd.
Chrome Gloss (Chrome finishing compound) W. Canning and Co. Ltd.
Cimalac (Insulating varnish) Pinchin, Johnson and Co.
Clarisco (Flat white paint) The Walpamur Co. Ltd.
Clarolac (Industrial enamel) Pilchers Ltd.
Clean It (Plater's general cleaner) R. Cruickshank Ltd.
Climax (Finishing mops) W. Canning and Co. Ltd.
Cockade (Hard gloss paint, superfine enamel, flat oil finishes) Federated Paints Ltd
Coilac (Electrical varnishes) Jenson and Nicholson Ltd.
Colasit (Fume neutralisation equipment) The Hockley Chemical Co. Ltd.
Colculac (Cold cure lacquer) British Cellulose Lacquers Ltd.
Coldkitt (Cold applied acidproof material) Prodorite Ltd.
Colorite (Opaque cellulose enamel) W. Canning and Co. Ltd.
Coltrate "A" (Acid resistant storage tank lining) Coltrate Ltd.
Combat (Fire Resisting paint) Pinchin, Johnson and Co.
Combinex (Stipple texture paint) Goodlass, Wall and Co. Ltd.
Combinol (Gloss, flat, eggshell and lustre finishes) Goodlass, Wall and Co. Ltd.
Comet (Steel wire wheels) W. Canning and Co. Ltd.
Comparator (Indicator papers) Johnsons of Hendon Ltd.
Congo (Brushes) Hamilton and Co. (London) Ltd.
Conquest (Fire extinguishers and appliances) The Pyrene Company Ltd.
Consol (Steel anchor floor plates) Prodorite Ltd.
Contor (Creped paper, masking and protective tape) John Gosheron and Co. Ltd.
Coo-Tex (Plastic paint powder) W. R. Cook and Co. (Paints) Ltd.
Cork-Tex (Anti-condensation paint) Thos. Parsons and Sons Ltd.
Corona (Filters for alkaline plating solutions) W. Canning and Co. Ltd.
Corona O.B. (Distemper) Federated Paints Ltd.
Corronon (Anti-rust paint) Henry Matthews and Co. Ltd.
Corticene (Anti-condensation paint) Pinchin, Johnson and Co.
Cosolyn (Degreasants, decarbonisers, paint removers, general cleaners) Industrial Colloids Ltd.
Cotswold (Dipping machines) Lionel Hook and Sons.
Cranco (Cellulose enamels and lacquers) Imperial Chemical Industries Ltd.

Crestamide (Sulphonamide resins) Scott, Bader and Co. Ltd.
Cromard (Hard chrome salts) The Hockley Chemical Co. Ltd
Cromus 97. (Polychromatic finish) Sherwood's Paints Ltd.
Crown (Felt polishing bobs and polishing compositions) W. Canning and Co. Ltd.
C.R.P. (Stopping-off lacquer for plating) Detel Products Ltd.
Cuirass (Water proofings, etc.) British Bye-Products.
Cuprobrite (Copper salts) W. Canning and Co. Ltd.
Cuprodine (For copper coatings to assist drawing of steel) Imperial Chemical Industries Ltd.
Cuteline (Paint) Cuteline Ltd.
Cyclo (Lining instrument) Cycle Gear Co. Ltd.
Cyclone (Spray units) Bylock Electric Ltd.

Danboline (Anti-corrosive paint) International Paints Ltd.
D.99 Lacquer (Wood finishes) Robt. Ingham Clark and Co.
Debecote (Anti-corrosive; fast water movement) Jenson and Nicholson Ltd.
Debonair (Synthetic emulsion paint) John Mathews and Co. Ltd.
Decdac (Enamel) Oliver Pragnell and Co. Ltd.
Decmetised (Protection of industrial structures) Prodorite Ltd.
Decmetising (Process for structural steelwork) Prodorite Ltd.
Decor (Enamel) Norman, Smee and Dodwell Ltd.
Deoxidine (Rust remover and metal cleaner) Imperial Chemical Industries Ltd.
Deoxylyte (for neutralising alkali residues on metal) Imperial Chemical Industries Ltd.
Deran (Derusting and passivating solution) The Walterisation Co. Ltd.
Detac (Water wash spray booth conditioner) The Pyrene Co. Ltd.
De Vilbiss (Spray-painting equipment) Aerograph Co. Ltd.
Devlo (Black enamel) H. Davison and Sons Ltd.
Dexcel (Cellulose lacquers) Dexter Paints Ltd.
Deydol (Washable water paint) Pinchin, Johnson and Co.
Deydolene (Sealer coat) Pinchin, Johnson and Co.
Diakon (Acrylic resin thermoplastic moulding powder) Imperial Chemical Industries Ltd.
Diamonite (Hardened cranolithic) Prodorite Ltd.
Diamond (Brushes) Marston and Co.
Diamond (Polishing composition) W. Canning and Co. Ltd.
Diluol (Toluene-substitute solvents) The Distillers Co. Ltd.—Chemical Division.
Dionic (Water purity testers) Evershed and Vignoles Ltd.
Dipsanil (Waterproofing agent) Imperial Chemical Industries Ltd.
Dingo (Paint cleaner) Yorkshire Dyeware and Chemical Co. Ltd.
Distrene British Resin Products Ltd.
Dixon's (Enamel paint and flat undercoating) Dixon's Paints Ltd.
Double Wear (Enamel) Ault and Wiborg Group.
Drysys (Industrial drying equipment) Carrier Engineering Co. Ltd.
Ducter (Low resistance testers) Evershed and Vignoles Ltd.
Ductilac (Plastic lacquers) Thornley and Knight Ltd.
Ductilac (Plastic peel) Thornley and Knight Ltd.
Ductiloid (Industrial cellulose lacquers) Thornley and Knight Ltd.
Ductoil (Electrostatic medium) Thornley and Knight Ltd.
Ductoil (Electrostatic stoving enamel) Thornley and Knight Ltd.
Ductoil (Hammered finish) Thornley and Knight Ltd.
Ductoil (Synthetic stoving enamels) Thornley and Knight Ltd.
Ductoil (Synthetic stoving wrinkle enamel) Thornley and Knight Ltd.
Duoflam (Burners) Radiant Heating Ltd.
Duomax (Plating barrel) W. Canning and Co. Ltd.
Du-lite (Gloss paint) Imperial Chemical Industries Ltd.
Dulux (Decorative, industrial and transport finishes) Imperial Chemical Industries Ltd.
Duradio (Enamel paint) The Walpamur Co. Ltd.
Duraflex (Leather wheels for bobbing) W. Canning and Co. Ltd.
Duratex (Synthetic emulsion paint) W. W. Hill, Son and Wallace Ltd.
Duridite (Spray degreaser for aluminium) Imperial Chemical Industries Ltd.

Ebonide (Black non-reflecting lacquer) W. Canning and Co. Ltd.
E.C.C. (Electroplating equipment) Electric Construction Co. Ltd.
Ecco (Compressors, spray painting guns and equipment) Atlas Copco (Gt. Britain) Ltd.
Edmontine (Enamel) Rolls and Co. Ltd.

Efco (Electroplating equipment, Udylite bright nickel) Electro-Chemical Engineering Co. Ltd.
Efco-Di-Phase (Metal cleaning equipment and processes) Electro-Chemical Engineering Co. Ltd.
Efco-Hendor (Electroplating filters) Electro-Chemical Engineering Co. Ltd.
Efco-Udylite (Electroplating plant and processes) Electro-Chemical Engineering Co. Ltd.
Electroline (Electric position proportioning control) Honeywell-Brown Ltd.
Electromel (Heavy smooth copper) J. P. Fielding and Co. Ltd.
Electronik (Potentiometers) Honeywell-Brown Ltd.
Electr-o-Pulse (Time proportioning control) Honeywell-Brown Ltd.
Electrovane (Electric control used with Electronik recorders) Honeywell-Brown Ltd.
Endolac (Insulating varnish) Pinchin, Johnson and Co.
Endurance (Polishing wheels) W. Canning and Co. Ltd.
Engenamel (Sealing finish for castings) Imperial Chemical Industries Ltd.
Enmatt (Flat oil paint) Enfield Chemicals Ltd.
Epalex B. J. Round and Sons Ltd.
Epikote (Resins) Shell Chemicals Ltd.
Epok British Resin Products Ltd.
Ercalene (Air drying, clear cellulose lacquers) W. Canning and Co. Ltd.
Everdure (Permanent greens) Morris and West Ltd.
Everseal (Liquid plastic, waterproofing compound) Everseal Products Ltd.
Evershed (Instrumentation) Evershed and Vignoles Ltd.
Evodyne (Paints) Evode Ltd.
Evredy (Liquid red lead (non-setting)) British Paints Ltd.
Excelclean (Electrocleaner-brass) R. Cruickshank Ltd.
Exeleyn (Industrial finishes) North British Chemical Co. Ltd.
Express (Non-inflammable paint remover) Pinchin, Johnson and Co.
Extinite (Fire resisting paints) British Paints Ltd.
Eziflo (Oil gloss paint) Whitehall Paints Ltd.

Fabriguard (Emulsion paint) Hangers Paint's Ltd.
Facix (Nickel salts) W. Canning and Co. Ltd.
Fairsyn (Enamel) The Fairfield Paint Co. Ltd.
Fasta (Rotary brushes, fibre and wire) The Hockley Chemical Co. Ltd.
Fastacut (Rotary fibre polishing brush) John Hawley and Co. (Walsall) Ltd.
Fasbond (Paint-bonding phosphate process) The Walterisation Co. Ltd.
Faspos (Fireproofing compound) Imperial Chemical Industries Ltd.
Fenal (Enamel) Fenner and Alder Ltd.
Fenaline (Hard gloss paint) Fenner and Alder Ltd.
Fencol (Wood preservative) Pinchin, Johnson and Co.
Ferramic (Frits and oxides for vitreous enamel) Ferramic Industries Ltd.
Ferrax (Metal cleaner) W. Canning and Co. Ltd.
Ferreko (Oil- resisting enamel, petrol-resisting compounds) British Paints Ltd.
Ferroclene (A remover of rust and scale) Sunbeam Anti-Corrosives Ltd.
Ferrogard (Paint and varnish) Quick and Co. Ltd.
Ferrogran (Metallic industrial floor surfaces) Prodorite Ltd.
Ferrolyte (Inhibitor for metal picking) The Pyrene Co. Ltd.
Ferromede (Temporary rust preventatives) Sunbeam Anti-Corrosives Ltd.
Fez (Paint) The Crown Compositions Co. Ltd.
Figaro (Hard enamel gloss paint) Pinchin, Johnson and Co.
Filkoat (Combined filler and undercoat paint) Fenner and Alder Ltd.
Filloid (Oil filler) Thornley and Knight Ltd.
Flaguar (Marine and insulating varnishes) Sandeman's Varnish Ltd.
Flame-Otrol (Combustion safeguard equipment) Ether Ltd.
Flatto (Flat white) Glasgow Patents Co. Ltd.
Fletto (Undercoat) Ripolin Ltd.
Flexemul (Emulsion bottom coating for leather) British Cellulose Lacquers Ltd.
Flexible Twilled (Emery cloth) John Oakey and Sons.
Flick (Easing oil) Fletcher, Miller Ltd.
Flintex (Varnishes, air drying enamels) Texalo Manufacturing Co. Ltd.
Floorine (Oil varnish stain) E. Parsons and Sons.
Floortherm Heaters (Convector heaters) Radiant Heating Ltd.
Flowlink (Conveyors) Fisher and Ludlow Ltd.
Fluocoat (Glossy fluorescent screen colours) Photocolour Laboratories Ltd.
Fluolac (Hard gloss fluorescent lacquer) Photocolour Laboratories Ltd.

Fluoprint (Fluorescent-coated paper) Photocolour Laboratories Ltd.
Fluorink (Matt fluorescent colours) Photocolour Laboratories Ltd.
Fluorsurf (Flat oil paint) Vulcan Products Ltd.
Foochow (Range of decorative industrial materials) Donald Macpherson and Co. Ltd.
Foo 3-4 (Synthetic decorative enamels) Donald Macpherson and Co. Ltd.
Forgemaster Ether Ltd.
Fortis (Varnish Brushes) The Briton Brush Co. Ltd.
Foscote R.S. (Cold brush-on treatment for rusty work) The Walterisation Co. Ltd.
Foundation (Aluminium priming paint) Norman, Smee and Dodwell Ltd.
Frestrex (Plastic paint) Imperial Chemical Industries Ltd.
Frigilene (Clear cellulose lacquer) W. Canning and Co. Ltd.
Furacin (A cement resistant to caustic alkalis, solvents, and hydrofluoric acid) Prodorite Ltd.
Fyrdura (Fire resisting paint) Docker Bros.

Gallay (Finishing barrels) W. Canning and Co. Ltd.
Galley (Paint and varnish) Thos. Hinshelwood and Co. Ltd.
Galvanax (Zinc salts) W. Canning and Co. Ltd.
Galvanite (Zinc solution addition agent) W. Canning and Co. Ltd.
Galvene (Inhibitor for metal pickling) Imperial Chemical Industries Ltd.
G.E.C. (Electrical equipment) The General Electric Co. Ltd.
Gemtone (Decorative paints) Ault and Wiborg Ltd.
General Body-White (Semi-prepared general purpose white) Donald Macpherson and Co. Ltd.
Glamel (Perfumed glass finish) Drynamels Ltd.
Glasso (Industrial enamels, synthetics, etc.) General and Industrial Paints Ltd.
Glazoid (Industrial finishes) Permoglaze Ltd.
Gleamax (Bright nickel plating solution) W. Canning and Co. Ltd.
Glendura (Hard gloss paint) St. Helen's Colour and Varnish Co. Ltd.
Glittax (Nickel brightening salts) W. Canning and Co. Ltd.
Glomur (Hard gloss paint) Ault and Wiborg Ltd.
Glossinal (Hard gloss paint) Goodlass, Wall and Co. Ltd.
Golden Glow Overhead Heaters (Space heaters) Radiant Heating Ltd.
Golden Fleece (Abrasive cloth) Jos. Stephenson and Co. (London) Ltd.
Goodray (Radiant heat stoving enamels) Goodlass, Wall and Co. Ltd.
Goodwall (Stove paint) Goodlass, Wall and Co. Ltd.
Graco (Polishing composition) W. Canning and Co. Ltd.
Grainette (Scumble graining colours) British Paints Ltd.
Granodine (Phosphate pretreatments for rust prevention) Imperial Chemical Industries Ltd.
Gransobian (Scumble, stain and glaze) R. R. Minton and Co.
Green Can (Varnish) Sherwood's Paints Ltd.
Gripoloid (Cellulose wood finishes) Pinchin, Johnson and Co.
Griponex (Glass fixtures) Pinchin, Johnson and Co.
Gripon Supervar (Varnish for general purposes) Pinchin, Johnson and Co.
Gripon (Adhesive cement, Mastic and sealer, chromatic jointing compound) Pinchin, Johnson and Co.
Gripon (Aluminium wood primer, concrete coatings, Fluid red lead, supernamel) Pinchin, Johnson and Co.
Gripso (Rubber solution) F. Ball and Co. Ltd.
Group 28 (Stoving finish) International Paints Ltd.
Gryphon (Fractional h.p. motors) Brook Motors Ltd.
Guardian (Varnishes) The Temple Varnish Co. Ltd.
Guideline (Road marking paints) British Paints Ltd.
Gunfalt (Gunned bitumen compounds) Prodorite Ltd.
Gunk (Degreasant fluid; greasy floors and plant) Bennett (Hyde) Ltd.
Guyson (Sand blast and shot blast cabinets and air compressors) Guyson Industrial Equipment Ltd.

Hadfield's (Paint remover) Hadfields (Merton) Ltd.
Hadrian (Enamels, primers, fillers and special finishes) Smith and Walton Ltd.
Hallmark (Flat white) British Paints Ltd.
Hallmaster (High-gloss enamel) John Hall and Sons (Bristol and London) Ltd.
Handyman (Light sanding and polishing machine) Electrix Ltd.
Hardchrome (Plating salts) R. Cruickshank Ltd.
Hard Drying Copal Oak (General purpose varnish) Pinchin, Johnson and Co.
Hardnick (Plating salts) R. Cruickshank Ltd.
Harlastone (Imitation stone paint) Wm. Harland and Son Ltd.

Harspray (Synthetic spray enamel) Wm. Harland and Son Ltd.
Hector (Totally submerged plating barrel) W. Canning and Co Ltd.
Hercules (Liquid stainers) Imperial Chemical Industries Ltd.
Heron (Paint and varnish brushes) Christopher Lang and Sons Ltd.
Hexavolt (Nickel salts for barrelling) W. Canning and Co. Ltd.
Hibitite (Pickle inhibitor) W. Canning and Co. Ltd.
Highway (Transport finishes) Jenson and Nicholson Ltd.
H.P.I.C. (Hygeia preparatory insulating coat) Pinchin, Johnson and Co.
Hoklykem (Plant and equipment) The Hockley Chemical Co. Ltd.
Holdenite S.E.P. (Self etch primer) Arthur Holden and Sons Ltd.
Holdenoid (Car cellulose lacquers) Arthur Holden and Sons Ltd.
Hoyflat (Flat oil paint) British Paints Ltd.
Hoytex (Plastic paint) British Paints Ltd.
Hulbrite (Boat varnish) Norman, Smee and Dodwell Ltd.
Hychrome (High-speed chrome plating solution) W. Canning and Co. Ltd.
Hydrovane (Rotary air compressors) Alfred Bullows and Sons Ltd.
Hygeia (Flat wall finishes) Pinchin, Johnson and Co.
Hyprez (Diamond lapping compound) Engis Ltd.

Ibex (White lead base oil paints) Associated Lead Manufacturers Ltd.
Imacula (Oil paints, varnishes, spirit enamels, synthetics) Modern Paints Ltd.
Indicorder (Recording and controlling pyrometers) Ether Ltd.
Indurin (Iron filler) Pinchin, Johnson and Co.
Inertol (Enamel waterproofing compounds) Inertol Co. Ltd.
Infray (Industrial finishes for infra-red stoving) Pinchin, Johnson and Co.
Institution (Hard gloss paint) Robert Kearsley and Co.
Insulus (Anti-corrosive stoving lacquer) British Paints Ltd.
Interlight (Plastic emulsion paint) International Paints Ltd.
Invicta (White zinc paint) Duresco Products Ltd.
Iridex (Zinc passivating salt) W. Canning and Co. Ltd.
Isocyne (Chemical resistant and rubber finishes) British Cellulose Lacquers Ltd.
Isolac (Insulating varnishes) Pinchin, Johnson and Co.
Isomeg (Insulating impregnating varnishes and wire enamels) British Cellulose Lacquers Ltd.
Ivodec (Oil-bound washable water paint) Johnson Bros. Ltd.
Ivomul (Emulsion paint) Johnson Bros. Ltd.

J and N (Liquid envelope peelable protective plastic coating) Jenson and Nicholson Ltd.
Japanol (Enamel, bath enamel) Japanol Enamel Co.
Jappolin (Enamel) John J. Bowater Ltd.
Jenolite (Industrial chemicals) Jenolite Ltd.
Jensolac (Coloured stoving enamels) Jenson and Nicholson Ltd.
Jensoloid (Cellulose lacquers) Jenson and Nicholson Ltd.
Jensove (Black stoving enamels) Jenson and Nicholson Ltd.
Jetrone (Bituminous paint) W. and J. Leigh Ltd.
Jif (Cleanser and water softener) Thompson and Co.

Kadax (Barrel cadmium salts) W. Canning and Co. Ltd.
Kadip (Bright dip for cadmium) W. Canning and Co. Ltd.
Kang-he (Enamel lacquer) James Rudman Ltd.
Kannilla (Case hardening compounds) W. Canning and Co. Ltd.
Kemick (Heat-resisting chemical paint) Imperial Chemical Industries Ltd.
Kemitone (Coach enamel) Lewis Berger (Gt. Britain) Ltd.
Kemobel (Anti-corrosive paint) Imperial Chemical Industries Ltd.
Kemprufe (Acid and alkali resisting paint) Thos. Horrocks and Sons Ltd.
Kemstrip (Enamel, lacquer and paint remover) The Hockley Chemical Co. Ltd.
Kestner (Refractory cement and concrete) Prodorite Ltd.
Keyolin (Enamel paint) Keystone Paint and Varnish Co. Ltd.
Kikem (Alkali neutraliser and sealer) R. J. Hamer and Sons (Paints) Ltd.
Kleenex (Metal cleaner) W. Canning and Co. Ltd.
Klenewell (Metal cleaner) W. Canning and Co. Ltd.
K. K. White (Chrome polishing composition) W. Canning and Co. Ltd.
Koperite (Cleaner and coppering salts) W. Canning and Co. Ltd.
Koplastic (Underwater paints) British Paints Ltd.
Korant (Aluminium cored lead anodes) W. Canning and Co. Ltd.
Krakloid (Crackle finishes) Pinchin, Johnson and Co.
Kremasticon (Hard gloss paint) Brown and Sons (Paints) Ltd.

Krislac (Frosting lacquers) Pinchin, Johnson and Co.
Kuprit (Plating salts) R. Cruickshank Ltd.
Kuretar (Varnish) Sherwood's Paints Ltd.
Kwick Shift (Paint remover) Brown and Sons (Paints) Ltd.

L (Process alkaline chromate oxidation treatment) The Walterisation Co. Ltd.
Lacoloid (Colloidal bituminous solution) British Paints Ltd.
Lacomatic (Lacquering machine) W. Canning and Co. Ltd.
Lacomit (Stopping off lacquer) W. Canning and Co. Ltd.
Lacquer 600 (Meat can lacquer) Robt. Ingham Clark and Co.
Lacrocel (Industrial cellulose and car finishes) British Paints Ltd.
Lactoil (Air drying enamel) Thornley and Knight Ltd.
Lactrene (Gum lacquer) W. Canning and Co. Ltd.
Lacwatt (Electrical insulating varnishes) Jenson and Nicholson Ltd.
Lagomatt (Flat oil paint) International Paints Ltd.
Laminite (Chemicals for insulating purposes) The Pyrene Co. Ltd.
Lancrema (Flat oil paint) North British Chemical Co. Ltd.
Lanitox (Rust inhibitive solutions) Drynamels Ltd.
Laybere (Nickel stripping solution) W. Canning and Co. Ltd.
Levelbrite (Bright nickel solution addition agent) W. Canning and Co. Ltd.
Lignolac (Furniture finishes) British Paints Ltd.
Ligstan (Liquid stainers) S. Bowley and Sons Ltd.
Lillinoid (Bituminous paints) George Lillington and Co. Ltd.
Linalin (Floor varnish) British Paints Ltd.
Linalux (Marine synthetic enamels and gloss paints) Imperial Chemical Industries Ltd.
Lion (Brushes) Davis, Burrow and Sons Ltd.
Liquid Solvex (Cold water cleaning agent) Fletcher Miller Ltd.
Lissapol (Synthetic cleanser and wetter) Imperial Chemical Industries Ltd.
Lithoform (Brushing pretreatment for zinc and galvanized iron) Imperial Chemical Industries Ltd.
Loadaveyor (Mobile inclined conveyor) J. Collis and Sons Ltd.
Lobosol (Low-boiling solvent mixtures) The Distillers Co. Ltd.—Chemical Division.
Locost Heaters (Space heaters) Radiant Heating Ltd.
Long Tom (Tractor tapes) E. A. Brough and Co. Ltd.
L.P.V. 1651 (White paint) The Leyland Paint and Varnish Co. Ltd.
Lubrol (Emulsifying agent) Imperial Chemical Industries Ltd.
Lumax (Bright nickel plating solution) W. Canning and Co. Ltd.
Lumeros (Heat-resisting aluminium paint) British Paints Ltd.
Lumeros X (Super heat resisting aluminium paint) British Paints Ltd.
Lusezy (Penetrating oil) P. Walker, Reid and Sons.
Lustalac (Polychromatic enamels) Jenson and Nicholson Ltd.
Lustre (Polishing compositions) W. Canning and Co. Ltd.
Lustrene (Oil, varnish, stain) Hudsons Paints Ltd.
Luxol (Pale synthetic varnish) British Paints Ltd.
Luxol 2 (Synthetic stoving finishes—smooth) British Paints Ltd.
Luxol 3 (Coach finishes) British Paints Ltd.
Luxol 4 (Synthetic spraying enamel—air drying) British Paints Ltd.
Lyco (Metal cleaning powder) W. Canning and Co. Ltd.
Lykem (Plating salts and chemicals) The Hockley Chemical Co. Ltd.
Lynopan (White enamel) Morris and West Ltd.
L.Z. (Lead and zinc paint) Whalley and Haddow Ltd.

Macsealer (Plaster primer and damp resister) Donald Macpherson and Co. Ltd.
MacWilson (Sanding discs) Flexible Abrasives Ltd.
Majestic (Tripoli polishing composition) The Hockley Chemical Co. Ltd.
Major (Plating barrel) W. Canning and Co. Ltd.
Marflux (Emulsion paint) Wm. R. Todd and Son Ltd.
Mastertherm Overhead Heaters (Space heaters) Radiant Heating Ltd.
Matsine (Stain and scumble) Mander Bros. Ltd.
Maxim (Plating barrel) W. Canning and Co. Ltd.
M.E.F. Combinol (Matt emulsion finish) Goodlass, Wall and Co. Ltd.
Megger (Insulation testers and earth testers) Evershed and Vignoles Ltd.
Meggerlac (Insulating enamel) Pinchin, Johnson and Co.
Melamine (Resin intermediate for manufacture of high quality synthetic paints varnishes and stoving enamels) The British Oxygen Co. Ltd.
Melanoid (Bituminous paints) Melanoid Ltd.
Meltic (Remover of stove enamel, etc.) Lewis Berger (Gt. Britain) Ltd.

Merol (Oil paint and primers) Thomas Merry and Co. Ltd.
Metabrite (Metallic finishes) Thom. Horrocks and Sons Ltd.
Metaclen (Cleaning salts—degreasing) The Hockley Chemical Co. Ltd.
Metallichrome (Motor-car finish) Imperial Chemical Industries Ltd.
Metalescent Polychromatic (Stoving and cellulose) Mander Brothers Ltd.
Metaprym (Aluminium wood primer) Lewis Berger (Gt. Britain) Ltd.
Metasheen (Polychromatic cellulose enamels) British Cellulose Lacquers Ltd.
Meteor (Resistance boards) W. Canning and Co. Ltd.
Methasol (Spirit soluble colours) Imperial Chemical Industries Ltd.
Met-L-Etch Primer (Etching primer) Robt. Ingham Clark and Co.
Metrovick (Electric motors, control gear, lamps, lighting, infra-red heating and drying) Metropolitan-Vickers Electrical Co.
Metso (Sodium matasilicate) Jos. Crosfield and Sons Ltd.
Mettal (Aluminium paint) British Paints Ltd.
Mica-Glip (Transparent glaze) J. H. Ratcliffe and Co.
Midget (Plating barrel) W. Canning and Co. Ltd.
Milkoid (Stain) J. Nicholson and Sons.
Minerva (Air drying synthetic coach finishes, bright part coating, superfine coach and motor materials, fire appliance red, machinery finishes, plastic wood, insulating varnishes) Pinchin, Johnson and Co.
Minerva (Marine varnishes, decorative paints, decorative varnishes), Pinchin, Johnson and Co.
Minifilter (High pressure filters) The Hockley Chemical Co. Ltd.
Minor (Plating barrel) W. Canning and Co. Ltd.
Miraculum (Graphite paint, red lead filler) British Paints Ltd.
Mirroflex (Enamel) Wm. Gibson and Sons.
M.L.A. (Anodes, all metals) M. L. Alkan Ltd.
Modutrol (Non-indicating modulating control system) Honeywell-Brown Ltd.
Monastral (Blue) Imperial Chemical Industries Ltd.
Mono (Nickel salts) The Hockley Chemical Co. Ltd.
Monomax (Automatic chrome plating barrel) W. Canning and Co. Ltd.
Monument (White lead paint) Jos. Chater and Sons Ltd.
Morrex (Wire and fibre brushes) B. O. Morris Ltd.
Morrisflex (Flexible shaft machines) B. O. Morris Ltd.
Morris (Non-stop polishing lathes; backstand idlers) B. O. Morris Ltd.
Mosaico (Metallic paint) Thos. Parsons and Sons Ltd.
Motoline (Car enamel) Thos. Parsons and Sons Ltd.
Mouldrite (Moulding powders and resins) Imperial Chemical Industries Ltd.
Murac (Flat wall paint) John Hall and Sons (Bristol and London) Ltd.
Muracqua (Flat emulsion paint) John Hall and Sons (Bristol and London) Ltd.
Muraprime (Alkali-resisting primer) Walter Carson and Sons Ltd.
Murisan (Latex emulsion paints and imitation stone paints) British Paints Ltd.
Muromatte (Flat oil paint) The Walpamur Co. Ltd.

N.D.K. (Stone preservatives) Pinchin, Johnson and Co.
Naplac (Lacquer paint) Knapman Bros. Ltd.
Nairolin (Oil gloss paint) A. Macnair and Co. Ltd.
Necol (Cellulose enamels, plastic wood and adhesives) Imperial Chemical Industries Ltd.
Necoloidine (Purified nitrocellulose) Imperial Chemical Industries Ltd.
Negro (Brushes) Crowden and Keeves Ltd.
Neogrene (Paints and varnishes) Printa Inks and Paints Ltd.
Neran (Leather glazing finish) Imperial Chemical Industries Ltd.
Newtherm Type U Overhead Heaters (Space heaters) Radiant Heating Ltd.
New Strip (Paint and varnish remover) Blyth, Heald and Langdale Ltd.
New Wrinkle (One coat texture stoving finish) British Paints Ltd.
Nicksal (Salts for barrelling) R. Cruickshank Ltd.
Nikstrip (Nickel stripping solution) R. Cruickshank Ltd.
Nimbus (Brushes) Bennett's British Brushes Ltd.
Nisica (Parting powder) W. Canning and Co. Ltd.
Nivo (Nickel plating salts) W. Canning and Co. Ltd.
Noflote (Pump control) Evershed and Vignoles Ltd.
Non-Flam (Fire resistant paint) R. J. Hamer and Sons (Paints) Ltd.
Norgren (Airline equipment) C. A. Norgren Ltd.
Noxo (Coal oil wood preservative) Newton Chambers and Co. Ltd.
Nulac (Synthetic varnish and enamel) Robert Kearsley and Co.
Nuron (Low-pressure laminating resin) Imperial Chemical Industries Ltd.

Nutralac (Anti-corrosive lacquer) Pinchin, Johnson and Co.
Nutraline (Bitumen linings) Tanks and Linings Ltd.
Nuvic (Flat wall paint) The Victoria Paint Co. Ltd.

Oblito (Undercoating white) Pinchin, Johnson and Co.
O.C.G. (Flat oil paint, etc.) George Farmiloe and Sons Ltd.
Office of Works Paint Thos. Parsons and Sons Ltd.
Ohmax (Rack insulating compound) W. Canning and Co. Ltd.
Olde English (Paint, varnish, etc.) S. Bowley and Son Ltd.
Onyx (Enamel) Beaver Paint Co. Ltd.
Opaceline (Flat white undercoat) Ault and Wiborg Group.
Opaline (Cellulose finish) Thos. Parsons and Sons Ltd.
Oralex (Metallic paints) Ferguson Edwards Ltd.
Orchaline (Food can lacquer) Robt. Ingham Clark and Co.
Oriental (High heat resistance and acid resistance lacquers) Donald Macpherson and Co. Ltd.
Oro (Metallic paints) Slick Brands Ltd.
Osram (Lamps and tubes) The General Electric Co. Ltd.
Ovarite (Enamel) Rolls and Co. Ltd.
Ozonic (Paints: marine) British Paints Ltd.

Paca (Composite boxes) Paton, Calvert and Co. Ltd.
Palustra (Pale inside varnish) British Paints Ltd.
Pammatt (Flat enamel) Blundell, Spence and Co. Ltd.
Paralac (Synthetic resin for varnish and enamel) Imperial Chemical Industries Ltd.
Parco (Chemicals for rust removing) The Pyrene Co. Ltd.
Parco Lubrite (Chemicals; anti-scuffing and wear resistance) The Pyrene Co. Ltd.
Parinfra (Infra-red stoving enamel) Thos. Parsons and Sons Ltd.
Parkerizing (Rust-proofing process) The Pyrene Co. Ltd.
Parlyte (Water paint) Thos. Parsons and Sons Ltd.
Parseal (Chassis protective clothing) Thos. Parsons and Sons Ltd.
Parso-Glaze (Scumble paint) Thos. Parsons and Sons Ltd.
Parsolac (Alkyd resin-based finishes) Thos. Parsons and Sons Ltd.
Parsonia (Paste filler) Thos. Parsons and Sons Ltd.
Parsonloid (Cellulose and wood finishes) Thos. Parsons and Sons Ltd.
Parso-Stain (Wood stain) Thos. Parsons and Sons Ltd.
Parso-Stone (Imitation stone paint) Thos. Parsons and Sons Ltd.
Parsymul (Synthetic emulsion paint) Thos. Parsons and Sons Ltd.
Pax's (White enamel) Pax Paints Ltd.
Peakite (Lead/zinc) Federated Paints Ltd.
Peeloff (Paint and varnish remover) Pinchin, Johnson and Co.
Peerless (Polishing compositions) W. Canning and Co. Ltd.
Penybron (Bronze plating solution) W. Canning and Co. Ltd.
Permacote (Paints) Solignum Ltd.
Permanent (Gloss enamel paint) Pilchers Ltd.
Perminal (Wetting-out agents) Imperial Chemical Industries Ltd.
Permoglaze (Industrial finishes) Permoglaze Ltd.
Petal (Caustic soda) Imperial Chemical Industries Ltd.
Phaltic (Bituminous paint) Thos. Parsons and Sons Ltd.
Phaltic (Bituminous paints; plastic compounds) Thos. Parsons and Sons Ltd.
Phomene (Fire extinguishers and appliances) The Pyrene Co. Ltd.
Pinchin Johnson's (Anti-corrosive paint, flat oil stain, oil varnish stain, paste paint in oil, etc.) Pinchin, Johnson and Co.
Plasoleum (A rubber latex cement for bonding bricks, tiles and paving forming underlays) Prodorite Ltd.
Plastipple (Plastic wall composition) Dixon's Paints Ltd.
Polo (High gloss enamel paint) Bitulac Ltd.
Polytone (Polychromatic paints) British Cellulose Lacquers Ltd.
Popoflat (Undercoating) Oliver Pragnell and Co. Ltd.
Power-Pulled (Overhead chain conveyor) Geo. W. King Ltd.
Preclad (Metal-prep primer/pretreatment) Pinchin, Johnson and Co.
Premier (Enamel) Docker Bros.
Preperite (Rust remover) The Pyrene Co. Ltd.
Primeseal (Sealer and primer) Keystone Paint and Varnish Co. Ltd.
Primix (Zinc chromate primer) Pinchin, Johnson and Co.
Prince (Tripoli polishing composition) The Hockley Chemical Co. Ltd.
Prodor (Silica graphite paint) Prodorite Ltd.

Prodoraqua (Liquid waterproofer and hardener) Prodorite Ltd.
Prodordur (Decorative floor surfaces) Prodorite Ltd.
Prodorfilm (A chemically resistant synthetic coating for concrete and steel) Prodorite Ltd.
Prodor-Glas (Synthetic enamel, hygienic linings) Prodorite Ltd.
Prodorglast (Protective coating for plating jigs) Prodorite Ltd.
Prodorglaze (Plastic texture wall finish) Prodorite Ltd.
Prodorkitt (Acidproof jointing compounds) Prodorite Ltd.
Prodorlac (Bituminous paint) Prodorite Ltd.
Prodorphalt (Acidproof asphalt) Prodorite Ltd.
Pronto (Paint remover) Federated Paints Ltd.
Protectoglo (Gas safety systems) Honeywell-Brown Ltd.
Protector (Oil paint, varnishes) Hudsons Paints Ltd.
Protectorelay (Combined flue thermostat and oil burner relays) Honeywell-Brown Ltd.
Prymetch (Zinc chromate etching primer) British Cellulose Lacquers Ltd.
Pultac (Spray booth strippable coatings) The Pyrene Co. Ltd.
Puma (Hard gloss paints) Bitulac Ltd.
Purex (Heavy duty plating cleaner) R. Cruickshank Ltd.
Purol-Flex (Finishing paint) Raines and Porter Ltd.
Pylumin (Chemicals; paint bonding to aluminium) The Pyrene Co. Ltd.
Pyrene (Fire extinguishers and appliances) The Pyrene Co. Ltd.
Pyrol (Paint remover) Farquhar and Co. Ltd.
Pyrobel (Heat- and flame-resisting finishes and dopes) Imperial Chemical Industries Ltd.
Pyroclean (Emulsion and alkali detergents) The Pyrene Co. Ltd.
Pyromac (low bake, maximum gloss, enamels) Donald Macpherson and Co. Ltd.

Q.Q. (Coach enamels) Holbrook and Illingworth Ltd.
Quickplate (Plating barrel) W. Canning and Co. Ltd.
Quicksnyth (Synthetic enamel) Postans Ltd.
Quilene (Paint remover) Beharell and Son Ltd.

Radex (Metallic paint) Sherwood's Paints Ltd.
Radiamatic (Total radiation pyrometer) Honeywell-Brown Ltd.
Radio (Rouge composition) W. Canning and Co. Ltd.
Redmanol (Phenolic synthetic resin) Bakelite Ltd.
Reflex (Polishing mops) W. Canning and Co. Ltd.
Reflexine (Hard gloss paint) Thos. Parsons and Sons Ltd.
Reliance (Steel wire brushing wheels) W. Canning and Co. Ltd.
Rembrandt (Decorative paints) Ault and Wiborg Ltd.
Remo-Cel (Paint and cellulose remover) Thos. Parsons and Sons Ltd.
Retortaline (Tinplate lacquer) Robt. Ingham Clark and Co.
Rex (Rotary files, cutters, and rasps) B. O. Morris Ltd.
Rhinide (Industrial resins, dipping, spraying, air-drying and stoving enamels) Goodlass, Wall and Co. Ltd.
Ribapake (Flat white paint) Ribble Paints and Varnishes Ltd.
Riccotine (Fish can lacquer) Robt. Ingham Clark and Co.
Ripon (Undercoat) Robert Kearsley and Co.
Rite-Off (Non-inflammable paint remover) British Paints Ltd.
Ritolastic (Bituminous coatings) Andrew Maxwell.
Robbialac (Decorative finishes) Jenson and Nicholson Ltd.
Rockfast (Nitrocellulose finish, also enamel paint) The Walpamur Co. Ltd.
Rockite (Synthetic resin moulding compositions, phenolic moulding materials, phenolic extrusions) British Paints Ltd.
Rocolene (Cold cleaner) R. Cruickshank Ltd.
Rodol (Rust preventatives, liquid and solid) Fletcher Miller Ltd.
Rolemul (Emulsion) Rolls and Co. Ltd.
Roltoflo (Paints for "Rotodip" plant) Pinchin, Johnson and Co.
Rosalin (Enamel) Craig and Rose Ltd.
Rosbonite (Tank coatings) Pinchin, Johnson and Co.
Rospen (Paint remover) Bitulac Ltd.
Rotamatic (Plating apparatus) W. Canning and Co. Ltd.
Rotary (Chrome plating plant) W. Canning and Co. Ltd.
Roto-Bonderite (Paint bonding treatment for motor bodies in "Rotodip" plant) The Pyrene Co. Ltd.
Rotodip (Automatic, cleaning rustproofing and priming plant for car bodies) Carrier Engineering Co. Ltd.

Roto-Finish (Precision barrelling machines and ancillary handling equipment) Roto-Finish Ltd.
Roto-Finish (Processing materials) Roto-Finish Ltd.
Roto-Ram, Roto-Tron, Roto-Matic (Special automatic finishing machines) Roto-Finish Ltd.
Rotospray (Car body finishing plant) Carrier Engineering Co. Ltd.
Rotunda (Filter) W. Canning and Co. Ltd.
Rowena (Hard gloss paint) Rowe Bros. and Co. Ltd.
Ruby (Brass salts) W. Canning and Co. Ltd.
Rust Anode (Cold galvanising) C. and P. Development Co. (London) Ltd.
Rust-Eeter (Primer for rusty surfaces) Thos. Parsons and Sons Ltd.
Rusticide (Black bituminous coatings) Pinchin, Johnson and Co.
Rustox (Paint) Tudors, Mash and Co. Ltd.

St. Paul's (Lead paint and varnishes) Blundell, Spence and Co. Ltd.
Safelec (Busbar syster) Geo. W. King Ltd.
Salamander (Heat resisting stoving enamels) Thornley and Knight Ltd.
Saldicas (Plating salts) R. Cruickshank Ltd.
Salubrine (Damp proof paint) Ault and Wiborg Ltd.
Sambo (Products) The Midland Buff Company.
Sanomur (Oil-bound water paint) Dexter Paints Ltd.
Satene (Greaseless polishing compositions) W. Canning and Co. Ltd.
Satinette (Enamels) Pinchin, Johnson and Co.
Scintilla Hammer Finish (Stoving and AD.) Mander Brothers Ltd.
Seafront (White gloss paint) Fenner and Alder Ltd.
Seekay Wax (Synthetic wax) Imperial Chemical Industries Ltd.
Serax (Leather contact wheels) W. Canning and Co. Ltd.
Severine (Rust removing solution) Fletcher Miller Ltd.
S.F.S. Bede (Hot spray machines) T.C. Spray Finishing Systems.
Sheencote (Flat finish) Vitretex (England) Ltd.
Siccoline (Liquid drier) Pinchin, Johnson and Co.
Sildal (Anti-corrosive) Silexore Ltd.
Silkas (Varnishes) Duresco Products Ltd.
Silkette (Stoving ripple finish) Pinchin, Johnson and Co.
Silvachrome (Plating salts) R. Cruickshank Ltd.
Silvercote (Silver finish, heat resisting) F. Hulse and Co. Ltd.
Silveroid (Metallic paint) Pinchin, Johnson and Co.
Silvoxite (Paint) James McNeil and Sloan Ltd.
Simplox (Open top containers) E. A. Brough and Co. Ltd.
Siotol (Anti-foaming agents) Imperial Chemical Industries Ltd.
Skalene (Descaling solution) W. Canning and Co. Ltd.
Slam (Synthetic enamel) Federated Paints Ltd.
Smith's John (Complete range of varnishes) British Paints Ltd.
Snappol (One coat spray enamel—air-dry 30 min.) Donald Macpherson and Co. Ltd.
Snowlac (Opaque white cellulose lacquer) W. Canning and Co. Ltd.
Soldox (Soldering flux) Pinchin, Johnson and Co.
Sollklean (De-oxidant) Pinchin, Johnson and Co.
Solvene (Paint and polish remover) Johnson Bros. Ltd.
Solventless (Electrical impregnating varnishes) Jenson and Nicholson Ltd.
Solvex (Degreasing crystals) Fletcher Miller Ltd.
Solwyte (White oil paints) Ault and Wiborg Ltd.
Speedex ("Spartan," "Solar," "Star" Tripoli polishing compositions) John Hawley and Co. (Walsall) Ltd.
Speedfix (Cellulose, self-adhesive tapes and paper and cloth masking tapes) Industrial Tapes Ltd.
Speedicut (Stitched polishing mops and rotary fibre brushes) John Hawley and Co. (Walsall) Ltd.
Speed Syntholux (Extra rapid air drying synthetic finish) Docker Bros.
Spra-Bonderite (Paint bonding treatments for use in automatic plants) The Pyrene Co. Ltd.
Spra-Bonderizing (Phosphating processes used in automatic plants for bonding paint to metal surfaces) The Pyrene Co. Ltd.
Spraycone (Spray nozzles) H. T. Watson Ltd.
Spraylite (Flat oil paint) Ault and Wiborg Ltd.
Spraymaster (Spray unit) Bylock Electric Ltd.
Spraytex (Fibres and adhesive) Spraytex (Manchester) Ltd.

Spraytex (Miserfibre gun) Spraytex (Manchester) Ltd.
Spraytex (Velvetronic electrostatic machine) Spraytex (Manchester) Ltd.
Springclear (High pressure filters) The Hockley Chemical Co. Ltd.
Stag (Red lead graphite primer, paints and enamels) Imperial Chemical Industries Ltd.
Stainol (Oil stain) Robert Kearsley and Co.
Stannine (Pickling inhibitor) Imperial Chemical Industries Ltd.
Star (Felt polishing mops and polishing compositions) W. Canning and Co. Ltd.
Starlac (Clear cellulose lacquer) W. Canning and Co. Ltd.
Steelax (Stainless steel green polishing compositions) W. Canning and Co. Ltd.
Stelasto (Shot-blast material) The Hockley Chemical Co. Ltd.
Stiroclean (Electrocleaner: steel) R. Cruickshank Ltd.
Stripalene (A remover of grease, dirt, oil and paint) Sunbeam Anti-Corrosives Ltd.
Striplac (Paint and lacquer and varnish remover) The Hockley Chemical Co. Ltd.
Stripnikrom (Chromium and nickel stripping solution) R. Cruickshank Ltd.
Strippo (Paint and varnish remover) Ferguson Edwards Ltd.
Stycco (Paste, rubber solution) F. Ball and Co. Ltd.
Styron (Polystrene moulding compositions) British Resin Products Ltd.
Submatic (Semi-automatic multiple barrel plating unit) W. Canning and Co. Ltd.
Suedeen (Flock adhesive undercoat) Cellon Ltd.
Suffield (Greens) Mander Brothers Ltd.
Suffolk (Factory paint) Keystone Paint and Varnish Co. Ltd.
Sumexol (Enamel paint) Sumex Paints Ltd.
Sun Brand (Varnish, enamel and paint) Ault and Wiborg Ltd.
Sun Dryers (Liquid driers) Ault and Wiborg Ltd.
Super (Felt polishing mops) W. Canning and Co. Ltd.
Super Gleamax (Bright nickel solution) W. Canning and Co. Ltd.
Superlative (Gloss paint, also metal primer) British Paints Ltd.
Supermatt (Flat oil paint) Imperial Chemical Industries Ltd.
Supertherm Overhead Heaters (Space heaters) Radiant Heating Ltd.
Superthetic (Decorative enamel) Arthur Holden and Sons Ltd.
Superva (Fadeless green enamel paints) Salford Paint and Varnish Co.
Suppelin (Cloth varnish) Pinchin, Johnson and Co.
Sundstrand (Pneumatic sanders) Sundstrand Pneumatic Sanders (Britain) Ltd.
Surtenax (Detergent) W. Canning and Co. Ltd.
Swansdown (Polishing mops) W. Canning and Co. Ltd.
Symphony (Paints) Coates Brothers Paints Ltd.
Synecraft (Inks for signwriters) Raines and Porter Ltd.
Synflex (Flat bottom coating for leather) British Cellulose Lacquers Ltd.
Synfred (Stove enamels for infra-red drying) Docker Brothers.
Synovar (Electrical impregnating insulating varnishes) Pinchin, Johnson and Co.
Synroz (Synthetic coach enamel and varnish) Donald Macpherson and Co. Ltd.
Synthoid (Synthetic lacquer) W. Canning and Co. Ltd.
Syronite (Anti-rust paint) Pinchin, Johnson and Co.
Szerelmey (Waterproof Encaustic decorative material for cement rendering) Szerelmey Ltd.

Tac-All (Tack rags) Tac-All Tack Rag (England) Ltd.
Tankoid (Aluminium paint) Docker Brothers.
Tectal (Wood preservatives) Imperial Chemical Industries Ltd.
Teepol (Surface active agent, wetting agent) Shell Chemicals Ltd.
Tekaloff (Paint and varnish remover) Thornley and Knight Ltd.
Tekard (Synthetic stoving enamels) Thornley and Knight Ltd.
Tekavite (Top-speed enamels) Thornley and Knight Ltd.
Teleflex (Conveyor equipment; remote controls) Teleflex Products Ltd.
Tellurine (Polishing powder) W. Canning and Co. Ltd.
Tenaceros (Acid resisting paints) British Paints Ltd.
Thermoclene (Air-drying drum lacquer) W. Canning and Co. Ltd.
30-minute (Rivelling enamels) Jenson and Nicholson Ltd.
Thornite (Agricultural implement paint) Thornley and Knight Ltd.
Thrifts (Anti-fouling compositions) Fenner and Alder Ltd.
Tilblast (Vapour blast equipment) Tilghman's Patent Sand Blast Co. Ltd.
Tilghman's Tilghman's Patent Sand Blast Co. Ltd.
Timborite (Wood preservative) Pinchin, Johnson and Co.
Tinalite (Transparent gum lacquer) W. Canning and Co. Ltd.
Tirrill (Voltage regulator) The British Thomson-Houston Co. Ltd.
Titanine (Industrial finishes) Titanine Ltd
Toneclad (Emulsion paints) Pinchin, Johnson and Co.

Tormura (Oil-bound washable water paint) Torbay Paint Co.
Translutex (Eggshell enamel) Donald Macpherson and Co Ltd.
Transoprint (Series of printed identification tapes) John Gosheron and Co. Ltd.
Transotape (Cellulose tape, plain transparent and colours) John Gosheron and Co. Ltd.
Transovil (PVC waterproof tape) John Gosheron and Co. Ltd.
Trident (Primer) Sherwood's Paints Ltd.
Trugrane (Oil scumbles) Leyland Paint and Varnish Co. Ltd.
Turpene (Turps substitute) Pinchin, Johnson and Co.
Turpona (Turps substitute) Pinchin, Johnson and Co.
Tynee (Filler) W. Canning and Co. Ltd.
Typhon (Plating barrel) W. Canning and Co. Ltd.

Unicote (Flat oil paint) Thos. Parsons and Sons Ltd.
Unistuc (Liquid stone) The United Paint Co. Ltd.
Universal (Varnish and white lead paint) Sherwood's Paints Ltd.
Universal (Primers and undercoating) British Paints Ltd.

Vamoset (Soap powder) Craig and Rose Ltd.
Valopan (Oil-bound water paint) North British Chemical Co. Ltd.
Varsolve (Paint remover) British Paints Ltd.
Veetex (Adhesive) Arthur Sanderson and Sons Ltd.
Velan (Textile waterproofing agent) Imperial Chemical Industries Ltd.
Velteen (Flat wall paint and insulating coat) Pinchin, Johnson and Co.
Velvoid (Black cellulose lacquers) W. Canning and Co. Ltd.
Venus (Liquid plastic coatings) Pinchin, Johnson and Co.
Vertex (Wire wheels) W. Canning and Co. Ltd.
Vetor (Cleaning salts—electrolytic) The Hockley Chemical Co. Ltd.
Victor (Chrome barrel) W. Canning and Co. Ltd.
Vigorised (Paints for wet on wet application) Pinchin, Johnson and Co.
Violux (Glass paint) Pinchin, Johnson and Co.
Vistalac (Optical black) Pinchin, Johnson and Co.
Vitableach (Wood bleach) Smith and Rodger Ltd.
Vitlac (Cellulose lacquers and enamels) The Durolac Co.
Vonite (Finishing composition for polishing plastics) W. Canning and Co. Ltd.
Vulcose (Cellulose motor finishes) Pinchin, Johnson and Co.
Vulkaset (Paint, varnish and enamel) Christopher Leng and Sons Ltd.

Waddomar (Oil-bound water paint) G. Wadsworth and Son Ltd.
Wahlide (Low relief finish and primer) Smith and Walton Ltd.
Waltergel (Thixotropic descaling jelly) The Walterisation Co. Ltd.
Warerite (Plastic surfacing material) Warerite Ltd.
Water Scumbles (For brush graining) J. H. Ratcliffe and Co.
Water-Tex (Plastic paint) Thos. Parsons and Sons Ltd.
Waxoline (Oil and wax soluble colours) Imperial Chemical Industries Ltd.
Weldtite (Brazing compound) W. Canning and Co. Ltd.
Wellingtonite (Aluminium oxide—abrasive papers and cloths) John Oakey and Sons Ltd.
Wellington (Abrasive papers and cloths) John Oakey and Sons Ltd.
Westalite (Plating rectifiers) Westinghouse Brake and Signal Co. Ltd.
Westropol (Solvent soap) Imperial Chemical Industries Ltd.
Whitcol (Emulsifying oils and agents) Imperial Chemical Industries Ltd.
White Gloss (Polishing composition for plastics) W. Canning and Co. Ltd.
Wilray (Hard gloss paint) Ault and Wiborg Ltd.
Wilverine (Enamel) Ault and Wiborg Ltd.
Wunderlac (Hard gloss paint) Cashmore and Co. Ltd.
Wyteceil (Ceiling distemper) Pinchin, Johnson and Co.
Wytone (Varnish) Dixon's Paints Ltd.

X.V. (Maintenance paint, red primer) Torbay Paint Co. Ltd.
Xorvarsten (Oil varnish stain) The Yorkshire Varnish.

Zincaclean (Electrocleaner; zinc base) R. Cruickshank Ltd.
Zincus (Plating salts) R. Cruickshank Ltd.
Zonax (Electroplating salts) W. Canning and Co. Ltd.
Zulosite (Wood preservative) R. R. Minton and Co.
Zulu (Liquid porcelain) F. Hulse and Co. Ltd.
Zyntax (Bright zinc salts) W. Canning and Co. Ltd.

FINISHING MATERIALS & EQUIPMENT

CLASSIFIED BY PRODUCT

For addresses see page 180

ABRASIVES
Abrasive Developments Ltd.
British Paints Ltd.
Canning, W. & Co. Ltd.
Cruickshank, R., Ltd.
Goldsworthy, Thos. & Sons Ltd.
Hawley, John & Co. (Walsall) Ltd.
Heddon-Smith (Overseas) Ltd.
Hockley Chemical Co. Ltd.
Minnesota Mining & Mnfg. Co. Ltd.
Morris, B. O. Ltd.
Oakey, John & Sons Ltd.
Steelbuffs Ltd.
Wengers Ltd.
Tilghman's Ltd.

ABRASIVE DISCS
B.U. Supplies & Machinery Co. Ltd.
Cruickshank, R. Ltd.
Goldsworthy, Thos. & Sons Ltd.
Morris, B. O. Ltd.
Oakey, John & Sons Ltd.

ABRASIVE PAPERS AND CLOTHS
Atlas Copco (Gt. Britain) Ltd.
B.U. Supplies & Machinery Ltd.
Canning, W. & Co. Ltd.
Carburundum Ltd.
Grauer & Weil Ltd.
Goldsworthy, Thos. & Sons Ltd.
Kingsland Eng. Co. Ltd., The
Minnesota Mining & Mnfg. Co. Ltd.
Oakey, John & Sons Ltd.

ABRASIVES (POWDERED)
Canning, W. & Co. Ltd.
Cruickshank, R. Ltd.
Goldsworthy, Thos. & Sons Ltd.
Grauer & Weil Ltd.
Oakey, John & Sons Ltd.
Steelbuffs Ltd.

ABRASIVE BELTS
Abrasive Developments Ltd.
Atlas Copco (Gt. Britain) Ltd.
Canning, W. & Co. Ltd.
Cruickshank, R. Ltd.
Goldsworthy, Thos. & Sons Ltd.
Grauer & Weil Ltd.
Hockley Chemical Co. Ltd.
Kingsland Eng. Co. Ltd., The
Minnesota Mining & Mnfg. Co. Ltd.
Morris, B. O. Ltd.
Oakey, John & Sons Ltd.
The R.J.H. Tool and Equipment Co. Ltd.

ABRASIVE WHEELS
Canning, W. & Co. Ltd.
Hockley Chemical Co. Ltd.

Heddon-Smith (Overseas) Ltd.

Sole agents for

SIA

Swiss Industrial Abrasives Ltd.,
Frauenfeld, Switzerland

Heddonia House, 374 Euston Road, London, N.W.1 Tel.: Euston 8501 (6 lines)

ACID AND ALKALI PROOF COATINGS
Ault & Wiborg Ltd.
Berger Lewis (Scotland) Ltd.
British Domolac Co. Ltd., The
British Paints Ltd.
Canning, W. & Co. Ltd.
Carrs Paints Ltd.
Cellon Ltd.
Cox Bros. & Co. (Derby) Ltd.
Cruickshank, R. Ltd.
Detel Products Ltd.
Evode Ltd.
Foster, Blackett & James Ltd.
General & Industrial Paints Ltd.
Harland, Wm. & Son Ltd.
Holden Arthur & Sons Ltd.
Imperial Chemical Industries Ltd
International Paints Ltd.
Jenson & Nicholson Ltd.
MacPherson, Donald & Co. Ltd.
Mander Brothers Ltd.
Metal Processes Ltd.
Parsons, Thos. & Sons
Pinchin, Johnson & Co.
Prodorite Ltd.
Sherwoods Paints Ltd.
Thornley & Knight Ltd.

ACID PROOF FLOORS
Metal Processes Ltd.
Prodorite Ltd.

ACID RECOVERY PLANT
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Berger Lewis (Gt. Britain) Ltd.
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Carrs Paints Ltd.
Cellon Ltd.
Cox Bros. & Co. (Derby) Ltd.
Evode Ltd.
Foster, Blackett & James Ltd.
General & Industrial Paints Ltd.
Goodlass, Wall & Co. Ltd.
Hall, John & Sons (Bristol & London) Ltd
Harland, Wm. & Son Ltd.
Holden Arthur & Sons Ltd.
Howse, Thos. Ltd.
Imperial Chemical Industries Ltd.
Ingham Clark, Robt. & Co.
International Paints Ltd.
Jenson & Nicholson Ltd.
Kearsley, Robt. & Co.
Leigh, W. & J. Ltd.
MacPherson, Donald & Co. Ltd.
Mander Bros. Ltd.
Metal Processes Ltd.
Parsons, Thos. & Sons
Pinchin, Johnson & Co.
Prodorite Ltd.
Ripolin Limited
Sherwoods Paints Ltd.
Starline Varnish & Enamel Co. Ltd.
Supra Chemicals & Paints Ltd.
Tabor Trego & Co.
Thornley & Knight Ltd.

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Cruickshank, R. Ltd.
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Grauer & Weil Ltd.
Hockley Chemical Co. Ltd., The

ADDITIVES
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Cruickshank, R. Ltd.
Electro-Chemical Engineering Co. Ltd.
Hockley Chemical Co. Ltd., The

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Berger Lewis (Gt. Britain) Ltd.
British Domolac Co. Ltd., The
B.U. Supplies & Machinery Co. Ltd.
Canning, W. & Co. Ltd.
Cellon Ltd.
Evode Ltd.
Gosheron, John & Co. Ltd.
Humber Oil Co. Ltd., The
Minnesota Mining & Mnfg. Co. Ltd.
Spraytex (Manchester) Ltd.

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Appleyard of Leeds Ltd.
Atlas Copco (Gt. Britain) Co. Ltd.
Atlas Plating Works Ltd.
Bullows, Alfred & Sons Ltd.
Canning, W. & Co. Ltd.
Cruickshank, R. Ltd.
Hockley Chemical Co. Ltd., The
Steele & Cowlishaw Ltd.

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Aerostyle Ltd.
Air Industrial Developments Ltd.
Atlas Copco (Gt. Britain) Ltd.
Blackman, K. Ltd.
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Heat & Air Systems Ltd.
Hockley Chemical Co. Ltd., The
Kingsland Engineering Co. Ltd., The
L.C.C. Technical College for the Furnishing Trades
Modern Industrial Ventilation & Oven Co. Ltd.
Morris, B. O. Ltd.
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Rayheet Ltd.
T.C. Spray Finishing Systems
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Bullows, Alfred & Sons Ltd.
Hockley Chemical Co. Ltd., The

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Bullows, Alfred & Sons Ltd.
Hockley Chemical Co. Ltd., The

AIR RECTIFIERS

Aerograph Company Ltd., The
Aerostyle Ltd.
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Berger, Lewis (Gt. Britain) Ltd.
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British Domolac Co. Ltd., The
British Paints, Ltd.
Carrs Paints Ltd.
Cellon Ltd.
Cox Bros. & Co. (Derby) Ltd
Docker Bros.
Evode Ltd.
Foster, Blackett & James Ltd.
Gay, R. & Co.
General & Industrial Paints Ltd.
Goodlass, Wall & Co. Ltd.
Hall, John & Sons (Bristol & London) Ltd
Harland, Wm. & Son Ltd.
Holden, A. & Sons Ltd.
Howse, Thomas Ltd.
Humber Oil Co. Ltd., The
Imperial Chemical Industries Ltd.
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International Paints Ltd.
Jenson & Nicholson Ltd.
Kersley, Robt. & Co.
Learner, A. & Co. Ltd.
Leigh, W. & J. Ltd.
Macpherson, Donald & Co. Ltd.
Mander Bros. Ltd.
Parsons, Thos. & Sons
Pinchin, Johnson & Co.
Reliance Chemical Co. Ltd.
Ripolin Ltd.
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Hockley Chemical Co. Ltd., The
Imperial Smelting Ltd.
Kingsland Eng. Co. Ltd., The
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Hockley Chemical Co. Ltd., The
Stordy Engineering Ltd.

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The R.J.H. Tool and Equipment Co. Ltd.

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Grauer & Weil Ltd.
Hockley Chemical Co. Ltd., The
Kingsland Eng. Co. Ltd., The
Metal Processes Ltd.
Preston, John & Co. Ltd.
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Hockley Chemical Co. Ltd., The
Modern Industrial Ventilation & Oven Co. Ltd.
Perfectair Ltd.
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Hockley Chemical Co. Ltd., The
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Cruickshank, R. Ltd.
Hawley, John & Co. (Walsall) Ltd.
Kingsland Eng. Co. Ltd., The
Klein, H. (London) Ltd.

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Berger, Lewis (Gt. Britain) Ltd.
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Cruickshank, R. Ltd.
Goodlass, Wall & Co. Ltd.
Hawley, John & Co. (Walsall) Ltd.
Hockley Chemical Co. Ltd., The
Kingsland Eng. Co. Ltd., The
Klein, H. (London) Ltd.
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Pinchin, Johnson & Co.
Reliance Chemical Co. Ltd.
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Sherwoods Paints Ltd.

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Hockley Chemical Co. Ltd., The
Kingsland Eng. Co. Ltd., The

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Berger, Lewis (Gt. Britain) Ltd.
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British Cellulose Lacquers Ltd.
British Paints Ltd.
Canning, W. & Co. Ltd.
Carrs Paints Ltd.
Cellon Ltd.
Cox Bros. & Co. (Derby) Ltd.
Docker Brothers
Gay, R. & Co.
General & Industrial Paints Ltd.
Goodlass, Wall & Co. Ltd.
Hall, John & Sons (Bristol & London) Ltd.
Harefield Industrial Paints Ltd.
Harland, Wm. & Son Ltd.
Hockley Chemical Co. Ltd., The
Holden, Arthur & Sons Ltd.
Howse, Thomas Ltd.
Humber Oil Co. Ltd., The
Imperial Chemical Industries Ltd.
Ingham Clark, Robt. & Co.
International Paints Ltd.
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Mander Brothers Ltd.
Parsons, Thos. & Sons Ltd.
Pinchin, Johnson & Co.
Reliance Chemical Co. Ltd.
Sherwoods Paints Ltd.
Tabor, Trego & Co.
Thornley & Knight Ltd.
Vulcan Products Ltd.

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Decospray Ltd.
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Howse, Thos. Ltd.
International Paints Ltd.
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Grauer & Weil Ltd.
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Roundhay Metal Finishers (Leeds) Ltd.
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Grauer & Weil Ltd.
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Grauer & Weil Ltd.
Hockley Chemical Co. Ltd., The
Kingsland Eng. Co. Ltd., The
Metal Processes Ltd.
Morris, B. O. Ltd.
Tilghman's Ltd.

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Honeywell-Brown Ltd.

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Cellon Ltd.
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Goodlass, Wall & Co. Ltd.
Grauer & Weil Ltd.
Hawley, John & Co. (Walsall) Ltd.
Hockley Chemical Co. Ltd., The
Kingsland Eng. Co. Ltd., The
Morris, B. O. Ltd.

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Hockley Chemical Co. Ltd., The

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Cruickshank, R. Ltd.
Metropolitan-Vickers Electrical Co. Ltd.
Teleflex Products Ltd.

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Atlas Copco (Gt. Britain) Ltd.
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Bullows, Alfred & Sons Ltd.
Carrier Engineering Co. Ltd.
Griffiths, A. E. (Smethwick) Ltd.
Heat & Air Systems Ltd.
Rayheet Ltd.
Stewart, Gill & Co.
Stordy Engineering Ltd.
T.C. Spray Finishing Systems
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Foster, Blackett & James Ltd.
Goodlass, Wall & Co. Ltd.
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Humber Oil Co. Ltd., The
Imperial Chemical Industries Ltd.
International Paints Ltd.
Jenolite Ltd.
Jenson & Nicholson Ltd.
Metal Processes Ltd.
Minnesota Mining & Mnfg. Co. Ltd.
Pyrene Co. Ltd., The
Ripolin Ltd.
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Sherwoods Paints Ltd.
Sunbeam Anti-Corrosives Ltd.
Wakefield, C. C. & Co. Ltd.
Walterisation Co. Ltd., The

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Kingsland Eng. Co. Ltd., The
Metal Processes Ltd.
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Tool Treatments (Chemicals) Ltd.

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Carrs Paints Ltd.
Cellon Ltd.
Cox Bros. & Co. (Derby) Ltd.
Detel Products Ltd.
Evode Ltd.
Foster, Blackett & James Ltd.
Gay, R. & Co.
General & Industrial Paints Ltd.
Goodlass, Wall & Co. Ltd.
Hall, John & Sons (Bristol & London) Ltd.
Harland, Wm. & Son Ltd.
Holden, A. & Sons Ltd.
Imperial Chemical Industries Ltd.
Ingham Clark, Robt. & Co.
International Paints Ltd.
Jenson & Nicholson Ltd.
Kearsley, Robt. & Co.
Leigh, W. & J. Ltd.
Macpherson, Donald & Co. Ltd.
Mander Brothers Ltd.
Metal Processes Ltd.
Parsons, Thos. & Sons
Pinchin, Johnson & Co.
Prodorite Ltd.
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Tabor, Trego & Co.
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Industrial Colloids Ltd.
Jenolite Ltd.
Kearsley, Robert & Co.
Kingsland Eng. Co. Ltd., The
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Metal Processes Ltd.
Pyrene Co. Ltd., The
Tool Treatments (Chemicals) Ltd.
Walterisation Co. Ltd., The

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Brent Chemical Products Ltd.
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Stordy Engineering Ltd.
Sunbeam Anti-Corrosives Ltd.
Tool Treatments (Chemicals) Ltd.
Walterisation Company Ltd., The

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Brent Chemical Products Ltd.
Canning, W. & Co. Ltd.
Cruickshank, R. Ltd.

Electro-Chemical Engineering Co. Ltd.
Jenolite Ltd.
Kingsland Eng. Co. Ltd., The
Mercol Products Ltd.
Metal Processes Ltd.
Tool Treatments (Chemicals) Ltd.
Walterisation Co. Ltd., The

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Jenolite Ltd.
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Round, B. J. & Sons Ltd.
Roundhay Metal Finishers (Leeds) Ltd.
Walterisation Co. Ltd., The

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Tool Treatments (Chemicals) Ltd.

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Hockley Chemical Co. Ltd., The
Kingsland Engineering Co. Ltd., The

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Bate, Wm. Ltd.
Cu-ni-craft Ltd.
Electro-Platers Ltd.
Harris Plating Works Ltd., The
Holmes Plating Co. Ltd.
Ionic Plating Co. Ltd.
Lofting Plating Co. Ltd.
Radiant Metal Finishing Co. Ltd.
Round, B. J. & Sons Ltd.
Roundhay Metal Finishers (Leeds) Ltd.

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STOVE ENAMELLING,
PHOSPHATING, etc.
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Hockley Chemical Co. Ltd., The

ELECTRIC MOTORS, RUSTPROOF

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Pinchin, Johnson & Co.
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Ripolin Ltd.
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Vulcan Products Ltd.
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President 1958-59: S. E. Clotworthy, B.Sc., M.I.E.E.

Vice-President: Maurice Cook, D.Sc., F.I.M.

Council: Sir Horace Clarke (James Booth and Co. Ltd.); Dr. Maurice Cook (I.C.I., Metals Division); Hon. Geoffrey Cunliffe (The British Aluminium Co. Ltd.), S. E. Clotworthy, Esq. (Northern Aluminium Co. Ltd.), W. Scott Warner, Esq. (H.D.A. Ltd.), B. R. Page, Esq. (John Dale Ltd.); E. Player, Esq. (Birmid Industries Ltd.); R. Hahn, Esq. (ALAR Ltd.); Basil James, Esq. (Reynolds T.I. Aluminium Ltd.); W. Brining, Esq. (Almin Ltd.).

Director-General : Air Commodore W. Helmore, C.B.E., Ph.D., M.Sc., F.C.S., F.R.Ae.S.

Technical Director : E. G. West, Ph.D., B.Sc., F.I.M.

The Aluminium Development Association is a technical consultative body, voluntarily sponsored and supported by the aluminium industry of Great Britain, with the object of encouraging the correct and increasing use of aluminium and its alloys. The Association co-ordinates effort and disseminates information for the mutual benefit of supplier and user but takes no part in the trading activities of its members.

THE chief aim of The Aluminium Development Association is to achieve the increased consumption of aluminium, including aluminium alloys, in all economically suitable forms. The policy of the Association is to attain this object by:

(1) Expanding existing uses of aluminium.

(2) Stimulating the development and establishment of entirely new uses of aluminium, including where necessary sponsoring the design and production of prototypes for practical demonstration.

(3) Assisting the development and establishment of uses of aluminium and its alloys by sponsoring research.

(4) Providing an authoritative and comprehensive technical information service about the properties and applications of aluminium, the choice of materials for specific purposes, and preferred methods of working, jointing, finishing, etc.

(5) Focusing attention on the merits of aluminium and the achievements of the industry by means of technical publications, lectures, films, and exhibitions.

(6) Providing a single organisation recognised by Government Departments, Public Authorities, scientific bodies, commercial organisations, and educational authorities, fully representative of the technical and development interests of the aluminium producing and fabricating industry as a whole.

Membership of the Association is open only to manufacturers with a primary interest in the production of raw or semi-finished aluminium or aluminium alloy products, and subject always to the Council's powers of admittance under the Articles of Association.

The general policy and control of the Association is in the hands of a Council which comprises representatives of Member Companies in accordance with the Memorandum and Articles of Association. The president and vice-president are elected annually.

BRITISH COLOUR COUNCIL

13 PORTMAN SQUARE, LONDON, W.1
TELEPHONE: WELBECK 4185

Patron: H.R.H. The Princess Margaret
Studio Director: Kathleen A. Battersby
Secretary: H. M. Blyth, C.A.

THIS is a non-profit making body representative of industry, working for industry—"for the co-ordination of colour and design."

It was conceived in the late twenties by a group of far-seeing industrialists with the object of creating a recognised system of colour determination, co-ordination and nomenclature. It was founded in 1930 and began active work in 1931 under the directorship of the late Robert F. Wilson.

The Council's services are available to industrial, business and professional organisations or individuals through membership in one or more of the following divisions: Women's Wear, Men's Wear, Children's Wear, Interior Decoration, or through Sectional membership. The Sectional membership meets the needs of dyers or manufacturers dealing with a particular fibre, irrespective of whether it is shown on Women's Wear, Men's Wear or Children's Wear cards.

Each Division has its own Committee representative of the interests concerned. The chairman and two delegates from each Divisional Committee, in addition to ten members elected from the general membership of the Council, form the Board of Management and determine the Council's policy.

Consultative Committees have also been formed, whose members are nominated by Trade Associations and who confer with the Council on special subjects affecting their own trade interests. The work of these Committees when linked with the work of a Technical Colour Reference Committee ensures that the ranges issued by the Council for any particular product are both economic and technically possible under present-day conditions.

The British Colour Council receives no grants or subsidies from any source, finance being provided solely through membership subscriptions and fees for special services. These services include the preparation of colour schemes for industrial premises for members and non-members.

Members are entitled to receive regular or special services according to the needs of their own particular commercial interests and individual requirements. They are also entitled to make use of the privileges and amenities of 13 Portman Square, London, W.1, which include:

Access to information on all colour problems at home and abroad.

Invitations to British Colour Council Exhibitions.

Facilities for exhibitions, which may be staged by Trade Associations or groups of member firms, showing, for example, the complementary products of allied trades.

Reference library containing books of historic, contemporary, commercial and scientific interest.

A place where members can arrange to meet and discuss matters of mutual interest and study trade and other publications.

THE BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION

EUSTON STREET, LONDON, N.W.1

TEL.: EUSTON 6411

Chairman of the Council: Dr. Maurice Cook
Director: G. L. Bailey, C.B.E., M.Sc., F.I.M.
Secretary: B. D. Doig

THE Association (founded 1920) is one of the group of industrial research associations formed under the aegis of the Department of Scientific and Industrial Research. The subscriptions of members are supplemented by a proportionate Government grant to give a total income of about £190,000 per annum. The Association is controlled by a Council elected from its members. Member ship is open to British, Commonwealth and Colonial companies, and at present comprises some 600 companies, including producers, fabricators and users of non-ferrous metals. The staff numbers over 175, including about 60 graduates. The Association is regularly carrying out research in many branches of non-ferrous metallurgy. There is a well equipped metal finishing department which, in addition to carrying out research on electroplating and allied processes, also provides technical advice to members on industrial problems.

The Association's work is carried out in three closely-integrated sections: the Research Department, which is much the largest; the Liaison Department, which assists members in applying research results on an industrial scale and also organises the provision of technical advice; and the Information Department and Library, serving both members and staff.

COPPER DEVELOPMENT ASSOCIATION

55 SOUTH AUDLEY STREET, LONDON, W.1

TELEPHONE: GROSVENOR 8811

Director: R. B. F. Wylie, B.A., B.L., LL.B.
Secretary: S. Baker, Ph.D., M.Sc., A.R.I.C.

THE Copper Development Association was founded in 1933 by the British copper industry with the object of extending and improving existing applications of copper and of developing new uses. It is a non-trading organisation and its services are available to all, free of charge or obligation. Its technical staff has expert knowledge of the applications of copper in the different industrial fields and may be consulted on any technical problem involving the actual or possible use of copper or its alloys. Members of the staff will be glad to visit enquirers to discuss their problems and to arrange for laboratory or workshop investigations to be carried out when necessary. The Association has issued many technical and semi-technical books on the production and use of copper and its alloys, and these are available (supplies permitting), free to those genuinely interested.

The Association's technical records on matters relating to copper and its alloys are among the most complete of their kind in the world; they and other sources of information available to the Association ensure that answers given to enquiries are up-to-date and as complete as it is possible to make them.

The services of the Association's staff are available for the purpose of lectures and demonstrations to technical associations, colleges, schools and other institutions, and of assisting in any other way in the training of students and apprentices. Technical literature and other aids to instruction, such as wall charts, and ore specimens, are provided free of charge and 16 mm. sound films are available on loan.

INSTITUTE OF METAL FINISHING

incorporating

ELECTRODEPOSITORS' TECHNICAL SOCIETY

32 GREAT ORMOND STREET, LONDON, W.C.1
TELEPHONE: CHANCERY 6793

President: R. A. F. Hammond, B.Sc., A.R.C.S., F.R.I.C.
Honorary Secretary: S. Wernick, Ph.D., M.Sc., F.R.I.C., F.I.M.
Honorary Treasurer: F. L. James

Local Branches:

London: Meetings held at Northampton Polytechnic, St. John Street, London, E.C.1.
Honorary Secretary of London Branch Committee:
W. E. Cattley, 89 Avondale Road, South Croydon. Croydon 8740

Midlands: Meetings held at the James Watt Memorial Institute, Great Charles Street, Birmingham 3
Honorary Secretary of the Midlands Branch Committee:
I. T. Watkins, Westalite House, Bradford Street, Birmingham 5. Midland 3368/9.

Sheffield and North-East: Meetings held at the Grand Hotel, Sheffield.
Honorary Secretary of the Sheffield and North-East Branch Committee:
B. Woffinden, 52 King Egbert Road, Dore, Sheffield.

North-West: Meetings held at the Engineers' Club, Albert Square, Manchester.
Honorary Secretary of the North-Western Branch Committee:
H. Maxwell, 48 Worsley Road, Worsley, Manchester.

Bristol and South-West:
Honorary Secretary of South-West Branch:
R. A. Wilding, 11 Fenton Road, Bishopston, Bristol 7.

Scottish: Meetings held at the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow. Honorary Secretary of in the Scottish Branch Committee: S. A. J. Murray, 1 Mansionhouse Road, Mount Vernon, Glasgow, E.2

[*Organic Finishing Group*]
Honorary Secretary: I. S. Hallows, B.A., 4, Ludgate Circus, London, E.C.4.

Meetings of the Group are held in various centres in the course of the session.

THE Institute of Metal Finishing originated in 1925 with the founding of the Electrodepositors' Technical Society and now has a membership of more than 1,600 with representatives from all over the world. The Institute's main object is the dissemination of technical information on metal finishing and allied subjects, and it provides a medium for the successful combination of the two essential elements in the industry—the practical worker and the research chemist. The Institute includes within its purview electrochemistry and electrometallurgy, with special reference to electroplating, electrotyping, the preparation, colouring and polishing of metals, the corrosion of metals and the protection of metals by electrodeposition, organic metal finishing and other coating processes.

Membership of the Institute is open to all interested in metal finishing. The annual subscription is £3 3s. 0d. with an entrance fee of £1 1s 0d. Student membership at special reduced fees is available to persons under twenty-one or between the ages of twenty-one and twenty-five and pursuing approved study. Corporate membership is open to organisations engaged in work relevant to the interests of the Institute.

Meetings at which papers of technical and practical interest are presented and discussed are held monthly

in London, Birmingham, Sheffield, Manchester, Bristol and Glasgow. The Organic Finishing Group, operating within the framework of the Institute, meets at different centres at approximately monthly intervals in the course of the session. A selected number of the papers read at Institute meetings and conferences, together with contributed accounts of research work, are printed and circulated to members as they appear. They are later bound into a volume which is published annually and is also free to members. Thirty-three volumes have so far been published.

A three- or four-day conference is held annually. International Electrodeposition conferences were organised by the Society in 1937, 1947 and 1954. Exhibitions, works visits and social functions are also arranged.

THE INSTITUTE OF FUEL

(Incorporated by Royal Charter 1946)

18 DEVONSHIRE STREET, PORTLAND PLACE, LONDON, W.1
TELEPHONE: LANGHAM 7124-5-6

President (from October 1958): T. C. Bailey, F.Inst.F.

Immediate Past President: H. McNeil, B.E., M.I.Mech.E., M.I.E.E., F.Inst.F.

Hon. Treasurer: R. H. Gummer, M.I.Mar.E., F.Inst.F.

Hon. Secretary: H. E. Crossley, M.Sc. Ph.D., F.R.I.C., F.Inst.F.

Secretary: R. W. Reynolds-Davies, B.Sc., M.I.Chem.E., F.S.S., F.Inst.F.

Section and Overseas Committees:

North-West, Merseyside, East Midland; Midland; North-Eastern; Scottish; South Wales; Yorkshire; India; Australia; Argentine.

THE objects are to promote, foster and develop the general advancement of the various branches of Fuel Technology as an end in itself and to the benefit of the community at large. To hold meetings in London and at established home and overseas centres for the reading and discussion of papers. To issue monthly a technical journal. To uphold the status of members of the Institute by holding or prescribing examinations for candidates for election and by requiring standards of knowledge and experience which can be approved.

THE INSTITUTE OF METALS

Founded 1908. **Incorporated 1910.**

17 BELGRAVE SQUARE, LONDON, S.W.1
TELEPHONE: BELGRAVIA 3291 and 3292

President: Marshal of the Royal Air Force, The Lord Tedder, G.C.B.
Secretary: Lieut-Col. S. C. Guillan, T.D.

LOCAL SECTIONS:

Birmingham: Hon. Sec.: A. W. Matthews, F.I.M., 23, Old Barn Road, Bournville, Birmingham 30.

London: Hon. Sec.: J. R. Knight, B.Sc., A.I.M., c/o Englehard Industries, Ltd., Baker Platinum Division, 154/170 Vauxhall Street, London, S.E.11.

Oxford: Hon. Sec.: D. B. Wright, B.Sc., Atomic Weapons Research Establishment, Aldermaston, Berks.

Scottish: Hon. Sec.: Matthew Hay, A. Cohen and Co. Ltd., Craigton Industrial Estate, Barfillan Drive, Glasgow, S.W.2. Halfway 4596/7.

Sheffield: Hon. Sec.: B. B. Argent, Ph.D., B.Met. Department of Applied Science, The University, St. George's Square, Sheffield 1. Sheffield 24071.

South Wales: Hon. Sec.: J. P. Dennison, Ph.D., B.Sc., Lon Bedwyn, Tycoch, Sketty, Swansea.

THE Institute of Metals--which is the technical and scientific society of the non-ferrous metal industries—was founded in 1908 to promote the science and practice of non-ferrous metallurgy in all its branches, and to facilitate contacts and the exchange of ideas among metallurgists, engineers, etc., by holding meetings and by the publication of literature. Its membership is international.

The main work of the Institute consists in the publication of a monthly periodical in which are included the Bulletin, the Journal and Metallurgical Abstracts (free to all members); in the publication of monographs and a quarterly periodical "Metallurgical Reviews"; the organisation of scientific and technical meetings, at home and abroad, for the presentation and discussion of papers; and the arrangement of visits to the works and institutions of metallurgical interest.

The **Bulletin** (first published in 1951) contains Institute news, letters to the Editor on scientific and technical matters, papers read before local sections, and other items of general interest to the members.

The **Journal** (85 volumes of which have been published) is issued monthly. It contains papers on original work, first-class reviews of knowledge in particular fields, addresses, lectures, and reports of symposia and discussions. It has a very wide circulation abroad.

Metallurgical Abstracts (General and Non-Ferrous) was originally bound with the Journal, and abstracts have been published since the Institute's foundation. The New Series (published monthly and bound annually) started in 1934 and has reached its 25th volume. The abstracts and reviews, which are prepared by experts, are acknowledged to be the most comprehensive and authoritative of their kind published in any part of the world and give a thorough coverage of the world's literature on general and non-ferrous metallurgy and allied subjects.

Monographs and Reports, etc. — Monographs and other publications are issued, prepared by acknowledged authorities. The value of, and demand for, these books may be gauged from the fact that one is in its seventh printing and others in their second and third printing.

Metallurgical Reviews.—A quarterly publication first published in 1956, with the object of providing authoratative, critical and interpretive reviews of knowledge gained in various fields of interest to metallurgists, to satisfy as wide a circle of readers as possible.

Local Sections and Associated Societies:—There are six Local Sections: Birmingham, London, Oxford, Scottish, Sheffield and South Wales. Each has its committee, and the chairman are ex-officio members of council of the Institute. In Manchester, Leeds, Liverpool, the East Midlands, the North-East Coast and Southampton areas the needs of local members are met by the co-operation with kindred local societies. The Local Sections meet the need for frequent winter meetings for lectures and discussions on matters mainly of direct industrial interest. Works visits are also arranged.

General Meetings:—At least two major General Meetings are held each year, in the spring and autumn, at which scientific papers are presented and discussed.

In addition, open discussions and symposia on specific subjects, the majority of which are of a practical nature, are arranged.

A Joint Library and Information Service (with the Iron and Steel Institute) is maintained at 4, Grosvenor Gardens, London, S.W.1. Books and periodicals may be borrowed free by members resident in Great Britain.

Instructional Meetings for Younger Members on inexpensive lines are arranged in centres of metallurgical interest in Great Britain and abroad.

Awards:—Generous specific donations have made possible the following annual awards: (1) the Institute of Metals (Platinum) Medal, in recognition of very distinguished services to non-ferrous metallurgy; (2) the W. H. A. Robertson Medal and Premium to authors of papers dealing with the engineering side of non-ferrous metal production; and (3) the Walter Rosenhain Medal in recognition of outstanding achievements in the field of physical metallurgy.

Membership

(1) **Ordinary Members** must be not less than 21 years of age and either (a) engaged in the manufacture, working on use of non-ferrous metals and alloys, or (b) of scientific, technical, or literary attainments connected with or interested in the metal trades, or with the application of non-ferrous metals and alloys, or engaged in their scientific investigation.

(2) **Junior Members** must be not less than 21 nor more than 28 years of age and (a) engaged in the manufacture, working or use of non-ferrous metals and alloys; (b) of scientific, technical or literary attainments connected with or interested in non-ferrous metallurgy or with the application of non-ferrous metals and alloys, or engaged in their scientific investigations; or (c) pupils or assistants of persons qualified for membership, whether such persons are members or not.

(3) **Student Members** must be not less than 17 and not more than 25 years of age and must be either (a) students of metallurgy, engineering, etc., or (b) pupils or assistants of persons qualified for ordinary membership, whether such persons are members or not.

Subscription.—Ordinary Members: £5 5s. 0d. p.a. **Junior Members:** £3 3s. 0d. p.a. **Student Members:** £1 15s 0d p.a. There is no entrance fee.

THE INSTITUTE OF VITREOUS ENAMELLERS

TELEPHONE: RIPLEY (near Derby) 136

Registered Office:

JOHN ADAM HOUSE, 17/19 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

President:

Chairman:

Secretary: Mr. J. D. Gardom.

Midland Section. Secretary: Mr. D. Sleath, Borax Consolidated Ltd., 87/89 Edmund Street, Birmingham 3.

Northern Section. Secretary: Mr. O. Dreyer, 15 Albermarle Avenue, Withington, Manchester 20.

Scottish Section. Secretary: Mr. G. R. Buchanan, Balbardie Ltd., 227 Bath Street, Glasgow, C.2.

The aims of the Institute are:—

(A) To promote the exchange of technical information between all sections of the vitreous-enamelling industry by (i) the publication of papers of a theoretical and practical nature; (ii) the holding of discussion meetings; and (iii) the preparation and circulation of technical reports, and to promote research and other scientific work in connection therewith or accessory thereto, and for that purpose to establish, equip and maintain laboratories or workshops and to conduct and carry on experiments and to provide funds for such work.

(B) To prepare, edit, print and publish, acquire and circulate books, papers and other literary undertakings bearing upon the said industry and to form and maintain libraries, statistics, scientific data and other information relating thereto and to disseminate the same, and to provide facilities for education and the statement, discussion and elucidation of scientific, technical and other problems in or related to the said industry.

THE INSTITUTION OF GAS ENGINEERS

17 GROSVENOR CRESCENT, LONDON, S.W.1

TELEPHONE: SLOANE 8266

Names of Officers:

President: E. M. Edwards, M.I.Mech.E.

Vice-Presidents:

D. D. Melvin

H. S. Cheetham, M.I.Mech.E.

Secretary: W. T. K. Braunholtz, O.B.E., M.A., Ph.D., F.R.I.C.

Assistant Secretary: A. G. Higgins, M.Sc., F.R.I.C., Barrister-at-Law.

District Sections and Affiliated District Gas Associations:

(a) The Institution of Gas Engineers—Eastern Section (incorporating the Eastern Association of Gas Engineers and Managers). Honorary Secretary: J. Hunter-Rioch, M.B.E., 52 Sidney Street, Cambridge.

(b) The Institution of Gas Engineers—London and Southern Section (incorporating the Southern Association of Gas Engineers and Honorary Secretary: J. Hunter-Rioch, M.B.E., 52 Sidney Street, Managers). Honorary Secretary: J. T. Veryard, B.Sc., South Eastern Gas Board, Katharine Street, Croydon.

(c) The Institution of Gas Engineers—Manchester and District Section (incorporating the Manchester District Association of Gas Engineers). Honorary Secretary: J. Castle, B.Sc., Gas Offices, Hind Street, Birkenhead.

(d) The Institution of Gas Engineers—Midland Section (incorporating the Midland Association of Gas Engineers and Managers). Honorary Secretary: D. K. Green, Gas Works, Foleshill Road, Coventry.

(e) The Institution of Gas Engineers—North of England Section (incorporating the North of England Gas Managers' Association). Honorary Secretary: J. R. Matthew, Northern Gas Board, Thomas Street, Consett, Co. Durham.

(f) The Institution of Gas Engineers—South Western Section (incorporating the Southern Association of Gas Engineers and Managers). Honorary Secretary: F. C. Gay, M.B.E., Radiant House, G.P.O. Box No. 141, Bristol 1.

(g) The Institution of Gas Engineers—Wales and Monmouthshire Section (incorporating the Wales and Monmouthshire Association of Gas Engineers and Managers). Honorary Secretary: J. Powdrill, M.B.E., Wales Gas Board, Bute Terrace, Cardiff.

(h) Irish Gas Association. Director: N. J. Robertson, Alliance and Dublin Consumers' Gas Company, Dublin, Eire.

(i) Scottish Association of Gas Managers. Honorary Secretary: W. Kirk, Inchgreen Gas Works, Greenock.

(j) British Junior Gas Associations' Joint Council. Honorary Secretary: L. G. Townsend, M.Sc., 39, Ravenswood Avenue, Rock Ferry, Birkenhead.

THE membership of The Institution of Gas Engineers, which continues to show a steady increase and is at present about 3,400, comprises gas engineers from all parts of the world, including suitably qualified coke oven technicians.

The Institution normally holds two General Meetings each year — the Annual General Meeting in May or

June, and the Autumn Research Meeting in November.

A benevolent fund, supported by voluntary contributions from members, is administered by the Institution for the benefit of necessitous gas engineers or their dependants.

One of the most important of the Institution's activities is the operation of a scheme of training and examination of young personnel entering the gas industry. The Associate Membership Examination of the Institution is conducted jointly with The Institution of Civil Engineers and the other engineering institutions. In addition, the Institution administers certain awards and scholarships.

Research and the accumulation and dissemination of technical information are also important functions of The Institution of Gas Engineers. Some former research activities of the Institution are undertaken by the Research Committee of the Gas Council.

The Institution has a number of standing technical committees responsible to the Council of the Institution, dealing with codes of practice, gas works safety, effluents, meters, gas distribution, and other technical matters concerning the gas industry.

THE IRON AND STEEL INSTITUTE

(Founded 1869. Incorporated by Royal Charter 1899)

4 GROSVENOR GARDENS, LONDON, S.W.1

TELEPHONE: SLOANE 0061

President: C. R. Wheeler, C.B.E.

Secretary: K. Headlam-Morley.

The Institute has no local branches.

THE objects of the Institute are the collection and publication of technical and scientific information relating to the making, shaping and use of iron and steel, and other subjects of interest to the Members. Two General Meetings are held annually, and other special meetings are arranged, for the discussion of technical papers. The Institute's Journal is published monthly.

A Metallurgical Library (Ferrous and Non-Ferrous) and Technical Information Service are operated by the Institute jointly with the Institute of Metals; these are used by both the Members and The British Iron and Steel Research Association. An Engineers Group caters for the requirements of those specially interested in engineering problems in iron and steel works.

The following awards are made annually by the Council: the Bessemer Medal, awarded in recognition of outstanding contributions to the advancement of the science of ferrous metallurgy and the manufacture of iron and steel; the Sir Robert Hadfield Medal, awarded to mark the Council's appreciation of meritorious service in improving the technique of the production of iron and steel or in developing the science of metallurgy, and as an encouragement for further work; the Williams Prize, awarded for the best practical metallurgical paper of the year published by the Institute, and the Ablett Prize, awarded for the best works' engineering paper of the year published in the Journal. Grants in aid of research work are made by the Council from the Andrew Carnegie Research Fund. Candidates must be under 35 years of age.

OIL AND COLOUR CHEMISTS' ASSOCIATION

Date formed: June, 1918 (incorporating in 1923 the Paint and Varnish Society)

General Secretary: R. H. Hamblin, M.A., F.C.C.S.

MEMORIAL HALL, FARRINGDON STREET, LONDON, E.C.4

TELEPHONE: CENTRAL 2120

Officers, 1958-59:

President: N. A. Bennett.

President Designate: P. J. Gay, B.Sc.

Hon. Treasurer: H. A. Hampton, B.Sc., Ph.D.

Hon. Secretary: J. E. Arnold, B.Sc., Ph.D., F.R.I.C., A.Inst.P.

Hon. Editor: M. H. M. Arnold, B.A., B.Sc., LL.B., F.R.I.C., A.M.I.Chem.E.

Hon. Research and Development Officer: J. B. Harrison, B.Sc., Ph.D., F.R.I.C.

THERE are three classes of members:—Ordinary: restricted to scientifically trained persons. Junior: under 25 years of age. Associate: open to persons interested in the industries covered.

Industries covered: paints and pigments, varnish oils, varnishes, lacquers, soap, essential oils, linoleum and treated fabrics, printing inks, natural and synthetic resins, related products and plant, apparatus and raw materials used in the above.

The purpose of the Association is to promote by discussion and scientific investigation the technology of the surface-coating industries, to inspire in members the highest ideals of a scientific vocation and to afford them opportunities for the interchange of ideas.

These are sections in Bristol, Hull, London, Manchester, Midlands (H.Q. Birmingham), Newcastle on Tyne, Scotland (H.Q. Glasgow), Australia, South Africa, New Zealand and West Riding (H.Q. Leeds).

Papers are given regularly by the Association and sections and well over seventy technical meetings are held each year in many parts of the Commonwealth. A Technical Education Committee set up by the Association has published two reports dealing with the problem of apprenticeship and vocational training in the paint, colour and printing ink industries.

Co-operative investigations by members of the Oil and Colour Chemists' Association are conducted by the Hon. Research and Development Officer. Conferences are held biennially, the 1957 Conference being on "Catalytic Processes Relating to the Surface-Coating Industries."

Technical Exhibitions are held each year in London for the display of advances in materials, equipment and technology within the industries. The Exhibitions arouse world-wide interest and attract 5,000 visitors annually.

Publications: Journal of the Oil and Colour Chemists' Association. Circulation over 4,000. Subscription rate to non-members, £5 per year in U.K., £6 per year abroad, including all indexes, post free. Issued monthly; "The Consolidated Indexes to Journal of the Oil and Colour Chemists' Association 1918-1945." 5s net.; "1946-1955." 10s 6d net; "An Introduction to Paint Technology," Pp. 154. Illustrated with Index. Reprinted 1957. 8s 0d (including postage).

Post-Graduate Lectures: "Physical Chemistry." E. J. Bowen. Pp. 32. 1953. 2nd Edition. 3s 6d net.; "Viscosity and Plasticity." E. N. da C. Andrade. Pp. 82. 1947. 10s net; "X-Ray Analysis and Radioactivity." Sir W. L. Bragg and H. J. Emeleus. Pp. 99. 1950. 12s 6d net.

In addition to the above publications, the Association is at present preparing a Technical Training Manual, in six volumes, on Paint Technology. It is hoped to publish the first of these volumes shortly.

PURCHASING OFFICERS ASSOCIATION

WARDROBE COURT, 146a QUEEN VICTORIA STREET, LONDON, E.C.4

TELEPHONE: CITY 3841-2-3

Patrons: Lord McGowan, K.B.E., D.C.L., LL.D.
The Earl of Verulam, M.A., F.I.I.A., J.P.

President: H. C. Exell, M.Sc. (North Thames Gas Board.)

National Chairman: A. H. Thomas (British Belting and Asbestos.)

National Vice-Chairman: A. Rochester (Hawthorn Leslie (Engineers) Ltd.)

Hon. Treasurer: A. N. Meier (The London Brick Co. Ltd.)

General Secretary: J. R. Blinch, F.C.I.S.

THE Association has forty-three district branches and groups in the principal centres of the U.K. and also in South Africa.

The Association was founded in 1931, and incorporated in 1935. Briefly its objects are: To maintain efficient purchasing in industrial and public undertakings; to safeguard the professional status of purchasing officers; to collect and circulate the information which purchasing officers need in the performance of their duties; to increase the technical and general knowledge of purchasing officers and their staffs, and to maintain a high standard of commercial morality and honourable practice in the conduct of business.

Membership is dependent upon the suitability of an applicants' appointment and experience in the purchasing field, and, in the case of those under 34 years of age, the passing of the Association's examinations. Through the Association's education scheme courses in purchasing and its allied functions are conducted at technical colleges throughout the country and correspondence courses are also available. In addition courses are conducted periodically for senior buyers.

The Association is active in representing the views of purchasing officers to the Government and to official bodies, and contacts are maintained with other purchasing organisations throughout the world.

The Association's monthly publication, "The Purchasing Journal," is available to non-members at 30s per annum. Its weekly publication, "The Purchasing Bulletin," containing market and similar information, is available to non-members at £3 13s. 6d. per annum. Special publications dealing with supplies matters are issued periodically.

An appointments register is conducted through which members are introduced to firms requiring purchasing staff. Another successful activity is the annual "Minibition," an industrial exhibition held in conjunction with the Association's national conference.

THE TIN RESEARCH INSTITUTE

Headquarters and Laboratories:

FRASER ROAD, GREENFORD, MIDDLESEX, ENGLAND

TELEPHONE: PERIVALE 4254

Technical Representation Overseas.

Belgium: Centre d'Information de l'Etain, 31 rue du Marais, Brussels

Canada: Technical Service Centre for Tin, Ontario Research Foundation, 43-47 Queen's Park, Toronto 5.

France: Centre d'Information de l'Etain, 1 Rue de Penthièvre, Paris 8.

Germany: Zinn-Informationsbüro, Kasernenstrasse 13, Düsseldorf (22a).

Holland: Technisch Informatie Centrum voor Tin, Louis Couperusplein, 19, The Hague.

Italy: Centro d'Informazioni dello Stagno, Via Manzoni 41, Milan.
Sweden: Teknisk Informations-Central for Tenn, Drottninggatan 14, Stockholm 16.
United States of America: Tin Research Institute Inc., 492 West Sixth Avenue, Columbus 1, Ohio.

THE Tin Research Institute is the headquarters of the International Tin Research Council which was founded in 1932 with the object of developing the consumption of tin. The Council is financed by the major tin producers of the world, and composed of delegates appointed to represent the industry in the Belgian Congo, Bolivia, France, Indonesia, Malaya and Nigeria. The Council also controls the organisations for technical development of tin in the countries listed above.

These organisations are engaged in spreading the new knowledge of tin throughout the world by publishing research results in the journals of scientific societies; by contributing articles to the technical and trade press; by issuing practical handbooks covering all the main industrial applications of tin; by giving lectures to learned societies, educational institutions and industrial bodies; by taking part in exhibitions and trade fairs; by practical demonstrations of new and established processes; and by visits to users' works.

The Tin Research Institute in England is engaged on scientific researches to develop new uses for tin and to improve existing tin products and the processes by which they are made.

Requests for information and assistance are welcomed and all information and technical service is provided free of charge.

ZINC DEVELOPMENT ASSOCIATION

34 BERKELEY SQUARE, LONDON, W.1

TELEPHONE: GROSVENOR 6636

Director: Mr. R. Lewis Stubbs, O.B.E.

THE Zinc Development Association is a non-trading organisation founded in 1938 and supported by all Commonwealth producers of zinc. It acts as an information bureau which provides all actual and potential users of zinc with free, up-to-date and impartial advice on the properties and various applications of the metal; and with its affiliated members, the Hot Dip Galvanizers, the Zinc Alloy Die Casters and the Zinc Pigment Development Associations it covers every use of zinc.

All enquiries are welcome and are dealt with by experts on the staff or on the Technical Committees of the affiliated associations; and visits are gladly paid to inquirers when necessary for discussion of their problems.

At the offices of the Association there is a permanent exhibition showing the different applications of zinc and photographs can be seen showing recent developments. Exhibitions on special subjects are arranged from time to time and particulars can be had on request. Visitors are welcome.

Among its many technical publications, of which a list can be had on request, are the Zinc Bulletin (a periodical) and the Z.D.A. Abstracts —a monthly review of recent technical literature from all countries, which circulates throughout the world.

The Association is in close personal contact with U.K., overseas and foreign firms with whom much information is exchanged on a reciprocal basis.

The Zinc Alloy Die Casters Association is a founder member of the European Pressure Die Casting Committee and the Hot Dip Galvanizers Association is a member of the European General Galvanizers Association.

The Z.D.A. library, which includes all important reference books on zinc and a very large number of British and foreign specialist journals, is always ready to lend material to bona fide enquirers. Lectures, illustrated by films and slides, are given to technical associations, colleges, institutes and schools. The names of suppliers of all kinds of zinc products are sent on request, and models and prototypes of interesting uses of zinc in building can be prepared on a strictly non-commercial basis.

THE ASSOCIATION OF METAL SPRAYERS

BARCLAYS BANK CHAMBERS, DUDLEY, WORCS.

TELEPHONE: DUDLEY 4045

Hon. Secretary: Mr. R. A. Parkes, F.R.I.C.

Hon. Treasurer: Mr. J. Pike.

THE principal objects are to promote, and further the interests of the industry of metal spraying by the wire process. To secure maximum production within the industry consistent with the maintenance of quality. To promote and encourage the interchange of technical knowledge amongst members.

To promote the study of and research into methods, costs of production and manufacture with a view to development of efficiency and economy therein. To conduct, prepare and finance publicity relating to the industry. To make provision for and to encourage settlement of disputes by arbitration. To co-operate with Government Departments in all parts of the world on matters relating to, or affecting the industry, and take such action in regard thereto as may be considered desirable.

Membership of the Association is limited to undertakings engaged in the business of metal spraying by the wire process (that is to say the system in which the metal to be sprayed is fed to the apparatus in wire form) or such other process as may be agreed by the Association. Members must be in business as public spraying contractors, or otherwise directly connected with the industry. The affairs are managed by an Executive Committee assisted by various Sub-Committees, and General Meetings of members are held at least four times per annum, technical discussions being invariably included in the programme. The Association from time to time organises displays at scientific and industrial exhibitions. Membership includes contractors in all parts of the United Kingdom and overseas.

BRITISH IRON AND STEEL FEDERATION

STEEL HOUSE, TOTHILL STREET, LONDON, S.W.1

TELEPHONE: WHITEHALL 1030

Outlying Departments:

Statistics Department, 7 Park Lane, London, W.1. Telephone: Mayfair 7676.

Commercial Organisations:

British Iron and Steel Corporation Ltd., 7 Park Lane, London, W.1. Telephone: Mayfair 7676.

B.I.S.C. (Ore) Ltd., 9 St. Helen's Place, London, E.C.3. Telephone: London Wall 6661.

Research Association:

The British Iron and Steel Research Association, 11 Park Lane, London, W.1. Telephone: Grosvenor 4751.

INFORMATION can be obtained from the Federation on such matters as iron and steel statistics, prices, general policy, publicity (including advertising, exhibitions and press), raw materials, steel production and supplies, exports, and economics.

There are a number of Member Conferences, which can be contacted through the Federation. They include sheetmakers, hot finished tube makers, alloy and stainless steel makers, and so on.

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K. J. Webb, Esq., D.S.C., F.B.I., Federation Chambers, Wheeler Gate, Nottingham. Telephone: 45184.

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London Area Office: St. Dunstans House, Carey Lane, London, E.C.2. (Telephone: Monarch 0871). Secretary: Mr. F. W. Bibb, A.C.I.S.

Scottish Area Office: 120 St. Vincent Street, Glasgow, C.2. (Telephone: Central 7223-4). Secretary: Mr. John Muir.

THE objects of the Association are to organise the Electro-Depositors, Finishers and Enamellers' Trade Sections and other members of the B.J.A. as a national association of individuals, firms or corporations operating in the electroplating, finishing or enamelling trades; to afford members an opportunity for interchange of views and for joint action in respect of matters generally affecting the trades or processes of members; to provide facilities for technical research and education; to promote and maintain standards of quality; to discuss the relations between employers and employees, including the questions of wages, hours of labour and working conditions and to act as a body of reference to negotiate or adjust any complaints or differences.

THE NATIONAL PAINT FEDERATION

PAINT INDUSTRY HOUSE, 79/80 HIGH HOLBORN, LONDON, W.C.1

TELEPHONE: HOLBORN 7991/4

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Mr. R. Lyall Keens, Paint, Colour and Varnish Trade Section, Bristol Chamber of Commerce, The Old Council House, Corn Street, Bristol, 1. (Telephone: 24518).

Mr. Matthew Niel, M.A., LL.B., Paint and Oil Section of the Chamber of Commerce and Manufacturers, 30 George Square, Glasgow, C.2. (Telephone: Central 8583).

Mr. Wm. Barr, Hull and Yorkshire Paint and Colour Manufacturers' Association, Samman House, Bowlalley Lane, Hull. (Telephones: Central 35825 and 35826).

Stead, Taylor and Stead, Liverpool and North-Western District Paint Manufacturers' Association, 5th Floor, 10 James Street, Liverpool 2. (Telephone: Central 1166-7).

Mr. Eric G. Sangster, London Colour, Paint and Varnish Manufacturers' Association, 79-80 High Holborn, London, W.C.1. (Telephone: Holborn 7991/4).

Mr. S. Owen, Midland Varnish, Paint and Colour Manufacturers' Association, The Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. (Tel. Birmingham Mid 1914).

Mr. P. R. Errington, North-East Paint, Colour and Varnish Association Section, Tyneside Chamber of Commerce, Guildhall, Newcastle-upon-Tyne 1. (Telephone: 22986).

R. H. March, Son and Co., South Wales Colour, Paint and Varnish Manufacturers' Association, Baltic House, Mount Stuart Square, Cardiff. (Telephone: 32255/6).

THE PAINT MANUFACTURERS AND ALLIED TRADES ASSOCIATION LIMITED

62 PUTNEY HIGH STREET, LONDON, S.W.15

TELEPHONE: PUTNEY 1735

President: G. E. Smith.

THE chief objects for which the Association is established are: (a) To protect the rights and interests of colour, paint, oil and varnish manufacturers, the suppliers of and dealers in colours, paints, oils and varnishes and the manufacturers and suppliers engaged in all trades which in the opinion of the Association are allied to the said trades throughout Great Britain and Northern Ireland by all such means and in all such ways as may from time to time be expedient.

(b) To consider, discuss and deal with any rules, regulations and conditions imposed or sought to be imposed upon the manufacture, commerce and trade of all Members of the Association by any Government Department, Ministry or other authority at home or abroad and to promote and support all measures in Parliament likely to be for the benefit of Members of the Association generally and to oppose any such measures as the Association consider to be likely to prove harmful to the interests of any Members of the Association.

THE SOCIETY OF BRITISH PAINT MANUFACTURERS LIMITED

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96 HAGLEY ROAD, BIRMINGHAM 16

TELEPHONE: EDGBASTON 4148—4149—4140

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Secretary: C. Hardeman Smith, Esq., M.A., F.C.A.

The Association is run entirely from the address mentioned above and there are no local branches or local secretaries.

THE objects of the Association are to deal with all commercial matters connected with Vitreous Enamelling and the affairs of the Association are run by a General Council, responsible to the members who meet regularly on matters concerning their trade.

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38 PORTLAND PLACE, LONDON, W.1

TELEPHONE: LANGHAM 8847/8/9

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General Secretary: W. E. Walters, F.I.E.D., F.R.S.A., F.F.C.S.

THE principal objects of the Institution are as follows: to promote the general advancement of the science of engineering design; to forward the practice and standardisation of engineering design; to forward the practice and standardisation of engineering draughtsmanship; to provide for the interchange and dissemination of technical or other information relating to the profession.

The Advisory Department, open to members of all classes, deals with matters relating to practical engineering draughtsmanship and design.

The Education Committee promotes education and training by courses, lectures and the publication of suitable papers, data sheets, and diaries. The Institution's Journal is issued free to members.

Branches of the Institution are established in England, Scotland and Wales.

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